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THE AMERICAN GAS LIGHT JOURNAL

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BRIEFLY TOLD.

ANNUAL MEETING OF THE SOCIETY OF GAS LIGHTING.—The Twentieth Annual Meeting of the Society of Gas Lighting was held in The Arena, No. 39 East 31st street, New York, on the afternoon of Thursday, December 13th. In the absence of the President, Mr. Joseph R. Thomas, and of the Vice-President, Mr. Eugene Vanderpool (who is in Europe), the Chair was occupied by Mr. James H. Armington; and the Secretary, Col. Fred. S. Benson, recorded the proceedings. The annual report of the Secretary disclosed a satisfactory growth in respect of the Society's development for the twelvemonth, and the Treasurer (Mr. A. M. Smith) gave figures which proved how careful he is in conserving its finances. The dark spot in the Society's records was furnished by Col. Benson's narration of the fact that death had invaded the ranks with startling frequency in the year, no fewer than three of those whom the Society held dear having passed away. The records told the story thus: Frederick A. Sabbaton[1] (non-resident), died April 14th; Henry F. Allen[1] (resident), died April 16th; Samuel George Stiness[2] (non-resident), died November 5th. The annual election resulted in the naming of the following executive management:

President—Joseph R. Thomas.
Vice-President—Eugene Vanderpool.
Secretary—F. S. Benson.
Treasurer—A. M. Smith.
Member of Executive Committee—F. C. Sherman.

It was determined definitely that hereafter all regular meetings of the Society set for the vicinity of New York shall be held in The Arena. Upon the conclusion of the routine business, the Society discussed the annual dinner, which was brought off in the pleasantly informal and harmonious way that always characterizes it.

ANOTHER DECISION BY THE MASSACHUSETTS BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS.—Our current item columns contain the pith of a decision recently handed down by the Massachusetts Board of Gas and Electric Light Commissioners, in the matter of the application of the Boston Electric Light Company for permission to increase its bonded indebtedness in the sum of $900,000. A very patient hearing was accorded the Company, and its counsel was given every opportunity to put the case in the most favorable light for his client; but, as is sometimes the fact, where such latitude is allowed, the counsel seems to have said a trifle too much, and so revealed a situation which looks to have been carefully scrutinized by the Commissioners. In appealing for the increase, counsel submitted a statement allotting to the several matters for which new capital was required the amounts so needed. From this it was seen that $300,000 was to be set aside to take up an existing mortgage of even amount, that $360,000 was to be used in the construction of underground conduits, and that the balance ($240,000) was needed for the purpose of wiping out a floating debt, which had been incurred "in one way and another." The statement looked to be all over a perfectly fair one, and the applicants evidently anticipated no denial of their prayer; But the Commissioners, having "slept upon it,"

1. For memorial action taken by the Society, see JOURNAL, April 30, 1894, p. 618.
2. " " " " " " Dec. 17, " p. 866.

decided that the Company, as to propositions numbers one and two, should not be refused, but they declined to accede to the soundness of the proposition that floating debts and bond issues were synonyms. They set this out, too, in terse and sound verse, the keynotes of which are to be found in our items. The ordinary business man cannot fail to comprehend the soundness of the position taken by the Commissioners, no matter whether such business man views the thing from the standpoint of a creditor or a debtor.

PALAZ'S TREATISE ON INDUSTRIAL PHOTOMETRY.—We are indebted to the D. Van Nostrand Company, of this city, for a copy of the work entitled "A Treatise on Industrial Photometry, with Special Application to Electric Lighting," by A. Palaz, who holds the Chair of Professor of Industrial Electricity to the University of Lausanne, Switzerland. The translation from the French was made by Mr. George W. Patterson, Jr., M.A., B.S., of the University of Michigan, assisted by Mr. M. B. Patterson, B.A., and the original text has lost nothing of its import or meaning through their joint transcription and translation. As its title indicates, the book deals in largest measure with the photometering, if we may so say, of lights resultant from electric currents; nevertheless, its first chapter, on the principles of photometry, is of worth sufficient to obtain for it a place on the shelves of the library of any gas photometrist. It is profusely illustrated, it is well printed and is substantially bound.

"CALCIUM CARBIDE," OR "LOAF SUGAR" ENRICHERS.—For some months past the gas men of the country have been more or less concerned over the claims made by the promoters of a process for the manufacture of what they term "pure acetylene" in solid form, that is, according to their story, about to revolutionize the manner and means at present employed for the enrichment of a "lean" gas; but our readers who have long-term contracts with existing corporations for the supply of the normal solid or fluid enrichers need not be alarmed that such contracts have a goodly life, for the "calcium carbide" or "loaf sugar" enricher is not to take the gas world by the ears just yet. Its promoters claim for it a yield of 10,000 to 12,000 cubic feet of 60 to 80-candle gas per ton (2,000 pounds) of the material, the cost of which to manufacture is put at $15 per short ton. We have good reasons for stating that under the conditions existing in this vicinity, the cost to manufacture it will not be less than $22 per ton, which puts it out of court with fair grade naphtha as an enricher, without making any note of the seeming instability of the gas produced. On page 903 we reprint an article, by Mr. Francis Wyatt, Ph.D., on this gas making substance, which is quite complete, and we supplement that hereunder by a note on it from the pen of President Morton, of the Stevens Institute of Technology, who thus speaks of calcium carbide in the October number of the *Stevens Indicator*, under the caption of "A Chemical Curiosity:"

Among the various uses to which electricity has been put, since its cheap production by the modern "dynamo" has been secured, is the reduction of metallic ores or compounds in one or another form of the "electric furnace." The production of aluminum on a large commercial scale is the oldest and best known of these. There are, however, several cases in which the separation of the single element is not secured even in the electric furnace, but in which the element desired, while parting with its former companions, insists upon a substitute, and t kes the same from the carbon electrodes or lining of the furnace, or from carbon mixed with it. This is the case in the manufacture of "carborundum," which is a compound of silicon and carbon, formed by heating silica and carbon powder in an electric furnace. This compound has reached a large commercial application, by reason of its extreme hardness, which makes it a very superior substitute for emery or corundum, as a cutting and polishing material. The latest development in this direction, however, is seen in the calcium carbide, which is prepared by heating in an electric furnace a mixture of lime and coal dust. The metallic calcium liberated by the action goes at once into combination with carbon to form a carbide, which is a mineral body of remarkable properties. In appearance, when in masses, it somewhat resembles the mineral serpentine, being of a greenish-gray color and crystalline fracture, with a luster like feldspar. If a few drops of water are thrown on this mass of seeming rock, gas is given off, which, if ignited, burns with a brilliant flame; and, by continuing, from time to time, to sprinkle the rock with water, it will be made to blaze continuously as though it was being sprinkled with some very volatile and inflammable oil. If a fragment of the mineral is thrown into a glass of water, a rapid evolution of gas results, which may be ignited, and will continue to burn until the mineral is exhausted. The cause of these actions is that the calcium carbide in contact with water forms calcium oxide and acetylene gas, the oxygen of the water combining with the calcium to form calcic oxide, or lime, and the hydrogen of the water combining with the carbon to form acetylene. It is proposed to use this calcium carbide for local gas machines. A charge of the mineral is placed in a closed vessel into which a regulated supply of water is admitted. A little water entering forms a quantity of gas whose pressure shuts off the water; but, as the gas is used up, more water comes in to renew the supply. What may be the commercial value of this material we are not prepared to say, but it is certainly a great chemical curiosity.

Prepayment Gas Meters as Sanitary Appliances.

The London *Journal* remarks that at the recent Congress of Hygiene and Demography, held at Budapest, a paper by Sir Douglas Galton, on the warming of dwelling houses, with special reference to central station heating arrangements, was read by Mr. John Slater. It has already been argued in the *Journal* that the present primitive method of heating houses in densely populated town areas by separate fires, involving a multiplicity of chimneys, must sooner or later give place, even in England, to some more systematic plan; and that the claims of coal gas to play an important part in connection with any scheme of improvement in this regard must not be overlooked. In so far as Sir Douglas Galton's paper is a contribution towards the formation of sound public opinion upon the essential principles of house warming, it is worthy of some attention. Unfortunately, the paper itself is padded out by the insertion of a quantity of superfluous matter, which is prejudicial to its effect as a whole; but it nevertheless contains some useful observations on the general subject, which is of sufficient intrinsic importance to engage the untiring study of all who have at heart the welfare of town populations. It is satisfactory to know that the London County Council are alive to the necessity of securing a sufficiency of light and air in and around the dwellings of the people, and are bent upon securing legislative sanction for a number of hygienic regulations having this object. It is something that instructed public opinion is coming to see—what has been asserted more than once in these columns—that the erection of so called improved artizans' dwellings in crowded neighborhoods has a tendency to increase the gloom of such localities; and in time it may become understood that the abolition of separate chimneys is the necessary complement of the steps that have already been taken in the direction of the improved housing of the poor in towns. There are large areas in London, to say nothing of other places, where one of the immediate consequences of the improved industrial dwellings movement has been the conversion of streets into the semblance of alleys wholly insufficient to circulate the quantity of fresh air necessary for the health of the crowded population, while such air as there is in the narrow gangways is darkened and polluted by the continuous smoke from tenfold the number of chimneys that once existed in the district. These places cry aloud for the relief which the "penny-in-the-slot" gas meter is fully qualified to supply; and if the gas companies which have an opportunity of making friends with the artizan population through the agency of this appliance only rise to the occasion, more will be done towards purifying town air than legislation could effect in a generation.

Sir Douglas Galton, in company with most professed sanitarians, fails as yet to perceive the possibilities of improvement here indicated; and thus he devotes the greater part of his paper to the discussion of the problem of warming as presented by dwelling houses of comparatively large size. Comparing coal fires with gas, he remarks that the former requires fuel to be continuously supplied in the room by manual labor; and the rooms heated by this means are entirely self-dependent. On the other hand, a gas fire also furnishes radiant heat. "It is supplied with fuel brought from a central source of supply. But the products of combustion from a gas fire are comparatively cool, and do not produce the same velocity in the chimney which a coal fire produces; and instead of favoring ventilation, it tends to cause the dispersion of those products in the room." This statement strikes us as not quite accurate. Most gas fires are fitted into a chimney, and most chimneys have an up-draught at all times, whether or not the products of a fire are passing into them. If a chimney has a bad draught, or none at all, even under the additional motive power supplied by a gas fire at the bottom of it, it could hardly be satisfactorily used for a coal fire. In another place, Sir Douglas Galton returns to the charge, saying that "gas stoves are convenient, in that the fuel is supplied without trouble; but the low temperature of the gases in the chimney favors the occurrence of back draughts." To this it might be replied that coal fires do not always burn with such intensity as to defy back draughts, and that a chimney which is liable to give trouble with a necessarily fluctuating coal fire is often good enough to serve for an equally burning gas fire. Sir Douglas Galton admits gas among the means whereby a combined system of heating many houses from one central source can be arranged.

With regard to the steam heating central stations of the United States, Sir Douglas Galton remarked that the system is more especially applicable to countries where the winters are uniformly and persistently cold. In England, the variations of temperature are so frequent and rapid, that while much heat is required at one part of the day, at another time this is not the case. Consequently, the frequent changes would make it difficult to provide economically for heating over a wide area. Thus the only system of heating from a central station other than by

gas which has proved practicable anywhere is inapplicable to the conditions prevailing in Great Britain. Yet, on a review of the whole question, Sir Douglas Galton thinks it is evident that much advantage to the population in a town would result from a central source of heat, without the inconvenience of having to carry fuel to every house. In a moderate sized house, the coal consumption is estimated at 20 tons a year—surely a high figure—and Sir Douglas Galton lays stress upon the labor of lifting the 2,000 scuttlefuls which this quantity means, when converted into the common domestic unit, and the toil and dirt of carrying away the ashes. In artizans' houses, the saving of trouble by central heating would be great. All the same, Sir Douglas Galton admits that, as steam is not available for this service, at any rate in England, there is nothing to be done but invoke electricity or fall back upon gas. Naturally, being a man of science, he prefers the former as being "most manageable and most hygienic." Unfortunately, however, it is extremely expensive, so that gas remains in possession of the field. Sir Douglas Galton's paper was followed by one contributed by M. Trélat, who, oddly enough, confessed himself an admirer of English open fires, "which cast through the dwelling the bright perspective of brilliant combustion, and afford the delightful convenience of immediately warming one or more members of the body on getting home on a cold night." During the discussion of these papers, Herr Frederick Siemens spoke, and subsequently introduced to the Congress his own system of gas heating by means of stoves embodying the principle of the recuperative gas burner, to which reference was made in a paragraph in the last number of the *Journal*.

It is eminently desirable that there should be the greatest possible amount of discussion of the subject of the warming of dwelling houses by improved systems; because all such debates end in fresh admissions of the fact that the only possible substitute for coal for this purpose is coal gas. On the occasion now in question, Sir Douglas Galton concluded with the familiar declaration that some cheap form of gas is best adapted for general use as a domestic heating agent. But this opinion is only the half-way house to the acceptance of ordinary coal gas as the *desideratum*. Once get it acknowledged that the fuel of the future—nay, for the immediate present—in towns must be gas, it is easy to show that the "cheap form" of gas which first recommends itself to hygienic reformers is a figment of the imagination. It is hardly too much to say that if gas, as at present sold for all purposes of lighting and heating, is not suitable for the applications Sir Douglas Galton had in view, neither it nor any other kind of gas ever will be. We lay stress upon this point, because there appears to be too much tendency on the part of professing hygienic reformers to prophesy good things to be done by fuel gas in the undated future, whereas the things can be had now for the asking. But it is not in houses where the consumption of coal is about 20 tons yearly that gas is likely to be best appreciated, either now or at any future time. Such a house implies a cook and several other servants, and a householder with an income sufficiently large for him to disregard small economies. Nothing less than an Act of Parliament would be efficacious in inducing such a householder to go without his smoking, blazing coal fire, if he had a fancy for it. Very different is the case of the artizan, who is now taking to gas with avidity, whenever and wherever he can get it by means within his compass. The fallacy of a special cheap gas supply is very apparent in this connection, for nobody would think of laying on two different kinds of gas to a cottage or tenement. Something that answers for fire and light as well is obviously what the poor man or the poor man's wife needs; and it is present in the popular pennyworth of coal gas. It is not necessary to ask an artizan to deliberately use a gas fire instead of coal. This would be to go upon the wrong tack. The right way is to give him a gas stove sufficient for the work of his small establishment, and a lighting burner or two; and then the smoky coal range will not be lit very frequently. This is a practical reform which there is every reason to hope will realize itself in an ever-swelling volume, while hygienic congresses are only talking about what may happen in the dim and distant future.

It is at least possible to say, what could not be said a year or two ago, that gaseous fuel is making its way rapidly among the poorer classes of the community; and this by virtue of a very slight alteration in the arrangements for its sale and delivery. So civilization advances by ways which open out where least expected, while the professional prophets stand aloof and look into vacancy for a deliverance that never appears from the most antecedently probable quarter. Five years ago nobody could have believed, if anybody had been found bold enough to say, that the most promising means of suppressing the smoke nuisance would be forthcoming in a small addition to the common, much abused gas meter. There was no apparent connection between the two ideas of gas measurement and the supplanting of coal fires by gas stoves. Now adays the connection has been established, and the unforeseen has become the commonplace. Wherefore we say that it will be well for our sanitary reformers if they will forthwith come down from the heights where nobody lives, and lend their aid and countenance to a movement which, albeit not of their starting, is likely to further their desires amazingly.

Calcium Carbide and Acetylene.

[Prepared by Mr. Francis Wyatt, Ph. D., for the *Engineering and Mining Journal*.]

If the problem of producing aluminum in great abundance and at a sufficiently low cost by direct reduction of clay has not yet been satisfactorily solved, the immense amount of experimental work which has been done in the endeavor to solve it, from the time of Sir Humphrey down to our own day, has been amply repaid, not only by the vast increase which it has added to our knowledge and experience of electrical smelting, but by certain other developments of great industrial importance which well merit the attention of chemists and engineers. It has proved to us, for example, that under the condition of intense heat, only obtainable in certain forms of electrical furnaces, the most refractory alkaline earthy metals may be deoxidized and formed into definite and more or less stable compounds with carbon, as may be demonstrated by the equation $CaO + 3C = CaC_2 + CO$, and there is thus opened up to us quite a new field in industrial organic chemistry. It is true that these compounds have long been known to us, but it is equally true that they have not been produced commercially for the reason that we have hitherto been unable to secure the intensity of temperature essential to their commercial production. In the year 1836 a by-product was obtained in the preparation of potassium, which decomposed water and gave off acetylene (C_2H_2) and which was found to be a compound of carbon and potassium. At about the same time Wohler made carbide of calcium experimentally, by subjecting to a high degree of heat an alloy of calcium and zinc mixed with charcoal, and found that it could be used for the production of acetylene. There was nothing of industrial consequence, however, in these discoveries, nor does anything appear to have been accomplished to attract attention to the carbides until the early part of 1892, when L. Maquenne (Comptes Rendus [115] 558-561) prepared barium carbide (BaC_2) by heating in iron bottles 26.5 grams barium carbonate, 105 grams powdered magnesium and 4 grams charcoal. He kept the bottle in a Perrot's furnace for 4 minutes, and found that the following reaction took place:

$$BaCO_3 + 3Mg + C = BaC_2 + 3MgO.$$

The cooled mass was amorphous, bluish gray and friable, and 100 grams of it yielded 5,200–5,400 c. c. of acetylene, mixed with some ⅓ per cent. of free hydrogen. The curiosity awakened by these results led to further investigation, and in a short time W. Travers (Proceedings of the Chemical Society of England [118] 15–16) devised another, although very similar, method of obtaining acetylene in comparatively large quantities. In the place of magnesium, Travers used metallic sodium, and a mixture of powdered calcium chloride and dried gas carbon (1:4). After properly closing his iron bottle and heating it in a furnace to a red heat for 30 minutes, he removed and cooled it with water. The brittle bluish-gray mass when broken out was in this case found to contain about 16 per cent. of calcium carbide (CaC_2) with some free carbon and some chloride and cyanide of sodium, and it gave off acetylene in satisfactory quantity when thrown into water.

While Maquenne and Travers were working on these lines, Mr. Thomas L. Wilson, of the Wilson Aluminum Company, was carrying on experiments in the manufacture of aluminum and calcium alloys at Spray, N. C. In the progress of these experiments, and while attempting to produce metallic calcium in his patent electric furnace, he succeeded in making, from a simple mixture of lime and carbon, and with a current of 4,000 to 5,000 amperes, a fused, black, homogeneous mass, which became solid and brittle when cooled. This substance was shown by analysis to be very pure carbide of calcium, of the formula CaC_2, and the gas which it evolved from the decomposition of water was pure acetylene, formed according to the reaction $CaC_2 + 2H_2O = C_2H_2 + Ca(HO)_2$.

This contribution to organic chemistry of a plentiful and cheap source of acetylene, by so easy and simple a method of making calcium carbide, must be regarded as one of the most important of the valuable resources added to the chemical industry by electrical engineers, and the Wilson Aluminum Company has shown its appreciation of it by continuing to manufacture the carbide on the small scale. A new corporation has also been formed, which is known as "The Electric Gas Company," and which proposes to erect a large new plant for its whole

sale production. The electrical furnace that is to be used is shown in the illustration, and was invented and patented by T. L. Wilson on February 21st, 1893, patent No. 492,337, his application having been filed in August of the previous year. *A* shows the outer masonry shell or bench of the furnace, *B* the carbon or graphite crucible or hearth, *C* the carbon bar or pencil constituting the movable electrode, and *D* the dynamo for generating the currents. From the terminal brushes of this dynamo, one wire *w* leads to and communicates with the crucible *B*, while the other wire *w'* leads to and communicates with the carbon pencil *C*. The connections are preferably made in the manner shown, the wire *w* being connected through a fastening bar to an iron plate *b* underlying the crucible *B*, and the wire *w'* being connected to a metal socket *c* embracing the upper end of the carbon pencil *C*. The bench *A* is made preferably of firebrick, which is a non-conductor of electricity, and the furnace is covered over with a plate, or preferably two plates *E E* of carbon having a central hole through which the carbon pencil *C* projects down into the crucible. For tapping out the resulting product, a tap-hole *d* is formed which in operation is closed by a plug *e* of alumina, clay or other suitable refractory material. The carbon plates *E E* rest on the top of the firebrick walls *A*, which project above the top of the crucible, forming an intervening space *f* for insulating purposes to prevent the short circuiting of the furnace between *B* and *E*. For the vertical adjustment of the carbon pencil, a screw-threaded shaft *g* is provided which may be propelled up and down by the engagement therewith of a suitably mounted rotative nut *h*.

Without entering into a detailed description of his process, its main features may be broadly stated as decomposing, deoxidizing, or reducing refractory metallic ores or compounds by subjecting them, while intimately commingled, or mixed with an excess of finely divided carbon, to the continued heat of an electrical arc. The mixed material being between separated electrodes and the arc being quite close to that portion immediately under treatment, the formation of a bath of fused compound, and the consequent ebullition and fluctuations in the resistance of the arc, are prevented by the presence of the carbon.

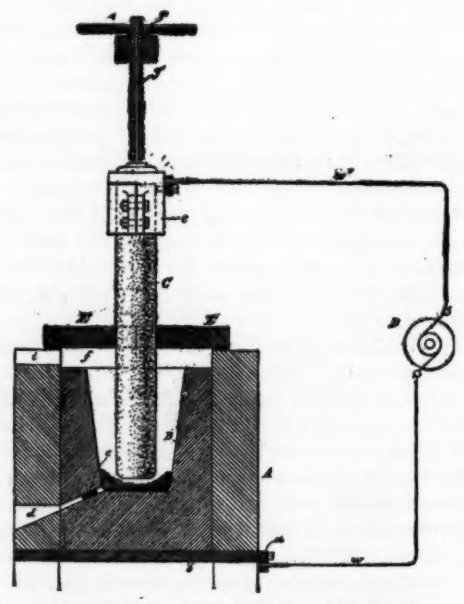
As the actual result of its recent practice, the Willson Aluminum Company has found that it can produce one short ton of calcium carbide from a mixture of 1,200 lbs. of fine coal dust and 2,000 lbs. of burnt lime, and at an expenditure of about 180 electrical horse power per hour for 12 hours. These figures are not very far from those required by theory, and they agree very closely with those given by H. Moissan, who has also produced the carbide in an electrical furnace of his own invention. It would, therefore, seem safe to formulate the approximate cost of production somewhat as follows for both the carbide and the acetylene.

1,200 lbs. coal dust, say	$2.50
2,000 lbs. powdered burnt lime	4.00
180 E. H. P. from water at, say, 50 per hour for 12 hours	6.00
Labor, etc	2.50
Cost per 2,000 lbs. CaC_2, say	$15.00
Cost per 2,000 lbs, C_2H_2, say	$37.00

These figures would hold good, not only for the present works in North Carolina, but at any other place where very cheap water power and equally cheap coal, lime and labor are procurable and accessible.

The specific gravity of calcium carbide is 2.22 at a temperature of 18° C., and, as may be judged from its formula, it is practically insoluble in all the ordinary reagents. Its qualities and characteristics have not been fully investigated, but Moissan has found that it may be heated in hydrogen gas, or exposed to nitrogen at 1,200°, or to the contact of silicon or boron at a bright red heat, without undergoing any change, and that it is not affected by sodium or magnesium at the softening point of glass, nor by tin at a red heat. At a higher temperature than a dull red heat it alloys with iron, and this is weli worth noting because it may be of interest in the future industry of steel. It becomes incandescent in contact with chlorine, bromine and iodine at the respective temperatures of 245°, 350° and 305°. It burns in oxygen, with formation of calcium carbonate, at a dull red heat, and at 500° it becomes incandescent in sulphur vapor, and yields calcium sulphide and carbon bisulphide. Water is decomposed by it very rapidly, and with evolution of pure acetylene, but its action upon steam is not so rapid, even when it is red hot, and the gas evolved is not pure acetylene, but contains free hydrogen. In dilute acids it behaves in the same way as with water, but it is only slightly attacked by fuming nitric and sulphuric acids, although ordinary sulphuric acid readily decomposes it, giving off an odor of aldehyde. Dry hydrogen chloride makes it incandescent, and the gas evolved contains a large proportion of hydrogen. With fused chromic anhydride it forms carbonic anhydride with incandescence, but with a solution of chromic acid it produces acetylene only. It is oxidized by potassium chlorate or nitrate at a red heat with incandescence, and formation of calcium carbonate. Lead peroxide oxidizes it with incandescence below a red heat, the reduced lead containing calcium, and it becomes incandescent by trituration with lead chromate at the ordinary temperature.

This rapid summary of the results of preliminary investigations would seem to strengthen the opinion already expressed that calcium carbide chiefly claims our attention as a practically unlimited and most convenient source of pure acetylene, and there is little reason to doubt that its utilization in this direction will soon cause it to be manufactured extensively in this and other countries.



Wilson's Electro-Smelting Furnace.

The hydrocarbon acetylene is regarded by chemists, and very justly so, as one of the most important intermediate bodies in the synthesis of organic compounds from their elements, and as one of the most interesting of the entire series. It is the only hydrocarbon that can be prepared directly from its free elements when the electric arc passes between carbon poles in an atmosphere of hydrogen, and it is worthy of consideration that this combination involves heat to the amount of 61,000 units. This tremendous energy explains why the sudden decomposition of acetylene evolves enough heat to raise the temperature to 3,000° and why the intense molecular vibration produced by detonating a minute quantity of mercuric fulminate in 25 c.c. of it causes a violent explosion accompanied with production of free hydrogen and finely divided carbon. It has been hitherto produced for commercial purposes by the incomplete combustion of coal gas according to the equation: $4CH_4 + 3O_2 = 6H_2O + 2C_2H_2$, and its purification has been effected by passing it through an ammoniacal solution of cuprous chloride and subsequently decomposing the red precipitate with dilute hydrochloric acid. This is, of course, a very costly and tedious operation, and is rendered a somewhat dangerous one by the highly explosive nature of copper acetylide.

It is a colorless and highly explosive gas, of very disagreeable smell, of specific gravity 0.91. It burns with a very smoky but much more luminous flame than olefiant gas, and undergoes complete combustion when mixed with oxygen in the proportion of 1 : 2½ vols. At a temperature of 1° C. and a pressure of about 725 pounds it becomes a mobile and highly refractory liquid much lighter than water, whereas by heating it in a sealed tube it is converted into a mixture of benzine (C_6H_6) and styrolene (C_8H_8). By passing sparks through a mixture of acetylene and nitrogen, hydrocyanic acid may be synthesized from its elementary constituents $C_2H_2 + N_2 = 2HCN$, and from this there may of course be produced the whole of the cyanides and a large number of other important organic bodies. If the red precipitate of cuprous acetylide be treated with metallic zinc in a solution of ammonia, nascent hydrogen is produced and ethylene or olefiant gas (C_2H_4) is formed. This in its turn can be combined with sulphuric acid to form sulphethylic acid ($C_2H_4 + H_2SO_4 = C_2H_5HSO_4$); and this, on being distilled with water, yields alcohol: $C_2H_5HSO_4 + H_2O = C_2H_6O + H_2SO_4$.

The fascinating scope for intelligent and painstaking research thus opened up in so many and so varied directions, must strike all those

who are in any way interested in organic chemistry as practically boundless, and the results will undoubtedly be revolutionary. For the purpose of giving us better and cheaper illumination than the ordinary coal, water and oil gases, acetylene is already occupying much attention, and it is from this direction that results will in all probability be first made apparent. The hydrocarbons of the ethylene and acetylene series give the illuminating value to gas made from the distillation of coal, while the illuminating value of water gas is derived from a mixture, with the non-luminous gases, of the same series of luminants obtained from the vaporization and cracking of petroleum oils. Since the power of the illuminants in any gas is in direct ratio to the relative proportion of its carbon and hydrogen, it must be plain that acetylene (C_2H_2), on account of its great proportion of carbon, must be highly diluted to prevent it from burning with a smoky flame. When, however, it is diluted by mixture in proper proportion, either with water gas or with ordinary atmospheric air, its flame is smokeless and of the utmost brilliancy and whiteness. The experiments that have been made by the Electric Gas Company have satisfactorily demonstrated that 1 short ton of calcium carbide will produce, by merely mixing it with water, about 10,500 cubic feet of acetylene, which, when mixed with the required amount of air, produces a gas equal in illuminating value to 100,000 cubic feet of city gas of 22 to 25-candle power per 5-foot standard burner. If to the estimated cost already given for the calcium carbide there be added say $15 per ton for freight, incidentals and profit, the material for producing such a gas could be obtained at nearly all points for 30 cents per 1,000 cubic feet, ready for burning, and the convenience with which the calcium carbide can be packed and freighted, combined with the easy preparation of the gas itself in great or small quantities, at any time, should enable it, if not to be adopted for the common supply of large cities, to supply the requirements of country hotels and of railway cars.

The Determination of Melting Points and the Composition of Some Candle Material.

[Contributed by Mr. W. E. Garrigues, to the Am. Chemical Society.]

The so-called melting point of a fatty substance is obtained in such a variety of ways, and with equally varied results, that the claim of a certain figure for any particular article of commerce is really of little or no value, unless accompanied by a description of the method employed in its determination, which for ordinary trade conditions is hardly feasible.

There is probably no method in common use, even comparatively independent of personal equations and respective laboratory conditions. Those proposed for determining melting points in capillary tubes, etc., besides being open to these objections, necessitate allowing the fat to harden for many hours before applying the test. Wiley's method for butter fat is both tedious and difficult of manipulation and of course useless for free fatty acids.

The solidifying point, after Dalican, is not infrequently reported as the melting point of stearic acid candles, and would if this were the only material employed, be an easy and fairly good solution of the problem; obviously, however, it is valueless for paraffine wax and even for many mixtures of the two. The writer believes that any procedure which will quickly give results on all kinds of candle material, the figures capable of being checked by different manipulators, is a much felt want among chemists engaged in such work.

In American oil refineries the melting point of paraffine is usually determined by immersing the bulb of the thermometer to two-thirds its length in the molten wax, which is then permitted to cool slowly until the first signs of incipient solidification appear on the surface, disregarding that portion in immediate contact with the sides of the dish. The height of the mercury is then read off.

In some works this is slightly varied by drawing the point of a pin across the surface of the melted wax, until a "string" of the latter can be picked up. This is regarded as the melting point.

A modification of Dalican's method, seemingly capable of universal application to substances solid at ordinary temperatures, was some time ago called to the writer's attention by Mr. Thomas S. Gladding. It consists of observing the temperature at which a fatty substance solidifies while in constant agitation.

The process is conducted by Mr. Gladding in the following manner: Thirty to fifty cc. of the dried sample is placed in a small beaker, the bulb of the thermometer is completely immersed therein and the glass with its contents twirled continuously in one direction until the mercury stops receding or ascending.

At first it falls rapidly and regularly, but its subsequent behavior varies with the nature of the substance under examination. With fatty acids there is a rise of from 0.1° to 1° C., averaging about 0.3° for commercial stearic acid; here it remains stationary for about one minute. With paraffine wax no rise results, but the mercury remains stationary about one-half minute and then continues to recede at the rate of 0.1° to 0.2° per minute. The fall prior to reaching this point being much swifter, no difficulty is experienced in noting the exact temperature. With mixtures of stearic acid and paraffine there is great diversity, the observed figures ranging from no rise to one of nearly 4°, the latter representing a mixture of two-thirds stearic to one-third wax.

Following is a table showing this melting point of such mixtures in different proportions. The last column gives the action of the mercury at the time of solidification:

	Stearic.	Paraffine.	Melts at	
1	100°	0	54.6°	0.1° rise.
2	100	10	53.4	No "
3	100	20	52.4	" "
4	100	30	51.6	" "
5	100	40	50.8	0.05 "
6	100	50	50.1	0.2 "
7	100	60	49.2	0.6 "
8	100	70	48.2	0.8 "
9	100	80	47.4	2.8 "
10	100	90	45.6	0.6 "
11	100	100	45.2	0.8 "
12	90	100	45.8	No "
13	80	100	46.3	" "
14	70	100	46.9	" "
15	60	100	47.3	" "
16	50	100	47.9	" "
17	40	100	48.6	" "
18	30	100	48.9	" "
19	20	100	49.6	" "
20	10	100	50.4	" "
21	0	100	50.8	" "

To check No. 9, the same paraffine was mixed with another sample of stearic, and gave:

Stearic.	Paraffine.	Melts at	
100°	0	53.1	0.6 rise.
100	20	50.8	0.6 "
100	40	49.0	0.7 "
100	60	46.5	3.6 "
100	80	45.9	3.1 "

NOTE.—These tables were constructed with a view to practical uses; hence, the proportions, as above, instead of even percentages reckoned on the mixture. In candle factories the predominant material is taken as a basis of calculation. Thus, 40 per cent. paraffine means 100 parts stearic acid to 40 parts wax.

The great advantage claimed for this method is the concordance of its results in different hands. The figures obtained are always the same to 0.1°. The only caution necessary is in cases where apparently no rise of the mercury will take place; the twirling motion should be continued until the mass assumes an unbroken white color and a homogeneous semi-solid consistency. This may take some minutes; then if still no rise occurs the temperature at which there was a pause is to be noted. A few trials with a mixture like No. 9 will make this clear.

The thing to guard against is being deceived by an action of the mercury similar to, say, No. 15. For several minutes before the enormous rise in the former, it almost stops, sinking no faster than after reaching the true point in the latter. The appearance of the substance under examination is, however, vastly different, being in No. 9 coarse, white flakes floating in a clear molten liquid. On continuing the motion, the mass suddenly blends to a solid white, the temperature rising rapidly; the highest point reached being the melting point. On paraffine wax the refinery test previously mentioned shows about 0.6° C. higher than Gladding's.

Chemists have for some time been aware that a mixture of fatty acids, subjected to distillation with superheated steam, undergoes some change. It is known that a quantity of liquid hydrocarbons is formed, together with a black pitch; also that there is a slight increment in the melting point. Alder Wright ascribes this latter to the possible formation of isoleic acid or stearolactone. A limited investigation by the writer, carried on at a large candle works, is felt to be a small grain added to a rather barren fund of literature on this subject.

An oft occurring mistake in connection with published analyses of candle material, is the omission of the details of manufacture. For instance, to give the average composition of commercial stearic acid, means absolutely nothing when we consider that one manufacturer em-

ploys palm oil as a source, while another uses tallow or bone fat. A third both saponifies and distills with steam, while a fourth uses sulphuric acid or presses the fatty acids directly without distillation. It therefore becomes essential to preface any report of this kind with a brief outline of the several stages through which the fatty substances pass.

The fats under consideration here are exclusively tallow and bone fat. These are saponified in an autoclave under 150 pounds steam pressure and without the aid of any base. All that is of sufficiently good color is then at once subjected to pressure at ordinary temperature, followed by a second hydraulic pressing, at steam heat. The solid cake of fatty acids thus obtained needs only to be freed from dirt before being ready for the candle molds. The oil expressed hot is permitted to chill, repressed cold, and the solid residue again subjected to the hot pressing. This is continuous, the cake from the hot press alone being used in the molding room.

The dark fatty acids, from the autoclave, before receiving the above treatment, are subjected to distillation, in copper, with superheated steam; 16,000 to 18,000 pounds constituting one "run," during which the volume in the still is kept constant by a continuous inflow from the storage tank above.

The distillate is caught in three fractions. The white oil, comprising about four-fifths of the whole, is obtained first. This we will call "first run oil;" it is ready for pressing at once. The hydrocarbons that are formed having, in part at least, a higher boiling point than the fatty acids, accumulate in the still, and when these begin to come over in quantity sufficient to color the distillate a decided green, the receptacle is changed. What now comes over we will term "second run oil;" it is returned to the storage tank and redistilled with the next run.

After a time the distillate again changes color, becoming darker and more viscid. The operation is then stopped and the contents of the still permitted to cool, subsequently being transferred to a smaller iron still in which a higher heat can be attained. The fraction obtained here we will designate "green oil." There now remains as a residue a black pitch, called "candle tar."

As will be seen later, from its analysis, the practice of returning this green oil to the storage tank, for redistillation with other fatty acids, cannot be looked upon in any other light than as an adulteration of the red oils, finally obtained, into which it finds its way.

Going back to the autoclave, we find little of interest except perhaps the degree of perfection attained by this mode of saponifying, without any base. Samples removed after 10, 12 and 14 hours digestion, showed respectively, 1.74, 1.44, 1.06 per cent. glycerol.

NOTE.—The unsaponified fat may be approximately deduced on multiplying these figures by 10.

As might be expected, no change occurred in the constitution of the fat, other than the removal of glycerol. Facilities for trying the effect of higher pressure than 150 pounds were lacking.

Proceeding to the distillation, we find the following changes take place:

Before Distillation.		After Distillation.	
Melting Point.	Oleic Acid.[1]	Melting Point.	Oleic Acid.
41.5	43.96 per cent.	44.5	35.06 per cent.
43.6	44.64 "	45.5	36.06 "
43.9	41.67 "	45.0	34.00 "

These melting points are lower than those of the pure fatty acids alone; due in the first column to the presence of neutral glycerides, to the extent of 10 to 15 per cent., and to hydrocarbons from a previous distillation, as before mentioned. Distillation almost eliminates the former, but the hydrocarbons are still there in about the same proportion (*vide infra*).

To determine quantitatively the changes wrought by the high temperature, about 260° C., a run of 16,075 pounds was traced through, and the chemical composition before and after noted, as well as the proportion of the different grades of oil previously named. These figures may be taken as typical, the variation from averages being very small.

The oil had a melting point of 43.2° C., and contained:

	Before Distillation.	After Distillation.
Solid acids	49.52 per cent.	50.47 per cent.
Oleic acid	42.86 "	33.05 "
Hydrocarbons (liquid)	6.94 "	13.14 "
Glycerol[2]	1.37 "	.....
Tar	....	2.00 "
Loss	....	1.34 "
	100.69 per cent.	100.00 per cent.

1. All the percentages of oleic acid given in this paper were obtained by calculation from the iodine absorption figure. The melting points are those described in the beginning of this article.

2. One-half the glycerol found is subtracted, together with oleic acid and hydrocarbons, from 100 to determine the solid acids, since tallow glycerides yield approximately 95 per cent. fatty acids and 10 per cent. glycerol.

The percentage yield of the different grades of oil and the constitution of each was:

First run oil...	80.31	Containing:	Hydrocarbon.	6.29 per cent.
Melting-point, 44.8			Fatty acids...	93.71 "
Second run oil.	12.13	Containing:	Hydrocarbon.	35.90 "
			Fatty acids...	64.10 "
Green oil.....	4.22	Containing:	Hydrocarbon.	98.74 "
Tar.....	2.00		Fatty acids...	1.26 "
Loss.....	1.34			
	100.00			

Making corrections for the hydrocarbons present before distillation and the glycerol, which forms a large part of the 1.34 per cent. loss, we have as a result of distilling 100 parts of pure fatty acids:

	Before.	After.
Solid acids	53.61	54.63
Oleic acid	46.39	35.77
Hydrocarbons (liquid)	....	6.71
Tar	....	2.15
Loss	....	0.74
	100.00	100.00

It seems reasonably assured, from these figures, that the stearic and palmitic acids distill without change, while the oleic partly splits up into liquid hydrocarbons, tar and a saturated or non-iodine consuming fatty acid. The nature of this body, though it has not been isolated, will be considered briefly farther on.

From the foregoing facts, it appears to the writer that the present process of manufacture might be advantageously altered by taking the fatty acids directly from the autoclave to the presses—as is done with the light colored stock—and obtaining a press-cake melting at 55°–56°, which latter is then subjected to distillation. By these means the candle stock would not deteriorate in the still as it now does (*vide infra*), and the formation of valueless—and even for most purposes harmful—hydocarbons would be avoided, giving the red oils a greater worth.

Practical candle makers find that distilled stock invariably yields a press-cake of lower melting-point than that from the autoclave. This is now explained by the formation of the saturated fatty acid from oleic acid in the still. This body is sufficiently solid to resist being pressed out with the oleic acid, yet soft enough to lower the melting-point of its associates—stearic and palmitic.

NOTE.—As shown by several writers, the lowering of the melting-point of a mixture of two fatty acids by the addition of the third, does not necessitate the latter having a melting-point below that of the two former.

Apart from the evidence already given its presence is indicated by its low molecular weight, being—probably considerably—under 268, while the mean of stearic and palmitic as occurring in tallow is 271–272. The following tabulated analyses of press-cakes in different stages of completion, illustrate these points.

	Autoclave Stock				Still Stock.		
	Melting-point, 0° C.	Per Cent. Oleic Acid.	Total mean Equivalent	Molecular Weight of Solid Acids.	Per Cent. Oleic Acid.	Total Mean Equivalent.	Molecular Weight of Solid Acids.
1....	51.0	....	....	....	16.69	...	....
2....	51.5	21.08	....	....	....	....	....
3....	53.6	....	....	....	7.02	....	....
4....	53.8	11.57	....	....	....	....	....
5....	54.1	9.00	....	....	....	....	....
6....	54.3	....	....	....	6.51	269.2	268.3
7....	54.4	8.04	....	....	5.51	269.2	268.4
8....	54.5	....	....	....	5.96	268.4	267.5
9....	54.6	....	....	....	6.00	268.0	267.0
10....	54.8	....	....	....	4.99	268.4	267.6
11....	54.9	6.60	272.0	271.2	4.16	270.0	268.4
12....	55.5	4.37	....	...	....	....	....
13....	55.6	4.02	272.0	271.5	....	....	....
14....	56.0	3.74	272.8	272.4	....	....	....
15....	56.1	3.96	272.0	271.5	....	....	....
16....	56.2	3.03	....	....	....	....	....

NOTE.—The average content of neutral glycerides was determined to be 3.90 per cent. in samples 11, 13, 14, 15, from the autoclave, which is offset by an average of 0.17 per cent. hydrocarbons in samples 6 to 11, inclusive, from the still. In calculating the mean equivalents, no corrections were made for these in either case. The method of determination was; boiling with an excess of alcoholic potash and back titrating.

To sum up, in conclusion, it appears that when oleic acid is distilled in an atmosphere of steam, the distillate contains, besides unaltered oleic acid, hydrocarbons—liquid, and mainly of high boiling-point—and one or more fatty acids, not isomerides of oleic, having a considerably higher melting-point and lower mean equivalent than the latter, and differing therefrom in not forming addition products with iodine. A black pitch remains as a residue in the still.

Galvanizing.

[Abstracted from a paper prepared by Mr. M. P. Wood, for the American Society of Mechanical Engineers.]

Galvanizing, as a protecting surface for large articles, such as enter into the construction of railway viaducts, bridges, roofs and ship work, has not reached the point of appreciation that possibly the near future may award to it. Certain fallacies existed for a long time as to the relative merits of the dry or molten and the wet or electrolytical methods of galvanizing. The latter was found to be too costly and slow, and the results obtained were erratic and not satisfactory, and soon gave place to the dry or molten bath process as in practice at the present day ; but the difficulty of management in connection with large baths of molten material, the deterioration of the bath and other mechanical causes, limit the process to articles of comparatively small size and weight.

The electro-deposition of zinc has been subject to many patents, and the efforts to introduce it have been lamentable failures in both a mechanical and financial sense. Most authorities recommend a current density of 18 or 20 amperes per square foot of cathode surface and aqueous solutions of zinc sulphate, acetate of chloride, ammonia, chloride or tartrate, as being the most suitable for deposition. Herman's process has been experimented with on a commercial scale, the chief feature being the addition of the sulphates of the alkalies or alkali earth to a weak solution of zinc phosphate. Electrolytes made by adding caustic potash or soda to a suitable zinc salt have been found to be unworkable in practice, on account of the formation of an insoluble zinc oxide on the surface of the anode and the resultant increased electrical resistance; the electrolytes are also constantly getting out of order, as more metal is taken out of the solution than could possibly be dissolved from the anodes by the chemicals set free on account of this insoluble scale or furring up of the anodes, which sometimes reaches $\frac{1}{8}$ inch in thickness.

To all intents and purposes the deposits obtained from acid solutions under favorable circumstances are fairly adhesive when great care has been exercised to thoroughly scale and clean the surface to be coated, and which is found to be the principal difficulty in the application of any electro-chemical process for copper, lead or tin, as well as for zinc, and that renders even the application of paint or other brush compounds so futile unless honestly complied with. Unfortunately, these acid zinc coatings are of a transitory nature, their durability being incomparable with hot galvanizing, as the deposit is porous and retains some of the acid salts, which cause a wasting of the zinc and consequently the rusting of the iron or steel. Castings coated with acid zinc rust comparatively quickly, even when the porosity has been reduced by oxidation, aggravated no doubt by some of the corroding agents, sal ammoniac, for instance, being forced into the pores of the metal.

Other matters of serious moment in the acid electro-zincing process, aside from the slowness of the operation, were the uncertain nature, thickness and extent of the coating on articles of irregular shape, and the formation of loose, dark colored patches on the works ; the unhealthy, non-metallic look and want of brilliancy and luster prevented engineers and the trade from accepting the process or its results, except for the commoner articles of use. The Cowper-Coles process of electro-zincing articles claims to overcome all these difficulties, and plants are in process of erection with a bath of some 14,000 gallons capacity, capable of turning out 40 tons of light work per week, and in which it is proposed to treat the plates of vessels 60 feet in length upon one or both sides, and the frames of such vessels as torpedo boat destroyers and kindred craft after riveting up. These plates and frames are given a thin coating of zinc by this process that appears to be perfectly uniform in character and extent, whatever the shape of the piece may be and however numerous the lugs, flanges, mortises or core holes, and is called "zinc flashing"—that is, coating the iron or steel article, after picking and cleaning, with a thin coat of zinc about one ounce per square foot of surface, which resists the inclemency of the weather and mechanical injury as well as a thicker coat, and is found to afford sufficient protection in most cases, and is adequate protection until such time as it is ready to receive the usual paint coatings.

To obviate any tendency of the paint to peel off from the zinc surfaces, as it generally manifests a disposition to do, it is recommended to coat all the zinc surfaces, previous to painting them, with the following compound : One part chloride of copper, 1 part nitrate of copper, 1 part sal ammoniac, dissolved in 61 parts of water, and then add 1 part commercial hydrochloric acid. When the zinc is brushed over with this mixture it oxidizes the surface, turns black, and dries in from 12 to 24 hours, and may then be painted over without danger of peeling. Another and more quickly applied coating consists of bichloride of platinum, 1 part dissolved in 10 parts distilled water and applied either by a brush or sponge. It oxidizes at once, turns black, and resists the weak acids, rain and the elements generally.

Zinc surfaces, after a brief exposure to the air, become coated with a thin film of oxide—insoluble in water—which adheres tenaciously, forming a protective coating to the underlying zinc. So long as the zinc surface remains intact, the underlying metal is protected from corrosive action, but a mechanical or other injury to the zinc coating, that exposes the metal beneath in the presence of moisture, causes a very rapid corrosion to be inaugurated, the galvanic action being changed from the zinc positive to zinc negative, and the iron as the positive element in the circuit is corroded instead of the zinc. When galvanized iron is immersed in a corrosive liquid, the zinc is attacked in preference to the iron, provided both the exposed parts of the iron and the protected parts are immersed in the liquid. The zinc has not the same protective quality when the liquid is sprinkled over the surface and remains in isolated drops. Sea air, being charged with saline matters, is very destructive to galvanized surfaces, forming a soluble chloride by its action. As zinc is one of the metals most readily attacked by acids, ordinary galvanized iron is not suitable for positions where it is to be much exposed to an atmosphere charged with acids sent into the air by some manufactories, or to the sulphuric acid fumes found in the products of combustion of rolling mills, iron, glass and gas works, etc., and yet we see engineers of note covering in important buildings with corrugated and other sheets of iron and using galvanized iron tie rods, angles and other construction shapes, in blind confidence of the protective power of the zinc coating ; else in supreme indifference as to the future consequences and catastrophes that arise from their unexpected failure.

The comparative inertia of lead to the chemical action of many acids has led to the contention that it should form as good if not a better protection to iron than zinc, but in practice it is found to be deficient as a protective coating against corrosion. A piece of lead-coated iron or terne plate placed in water will show decided evidences of corrosion in 24 hours. This is to be attributed to the porous nature of the coating, whether it is applied by the hot or wet (acid) process. The lead does not bond to the plate as well as either of the other metals, zinc, tin, copper or any alloys of them. The usual weight of lead-coated terne plates is about $\frac{3}{4}$ ounce to a square foot, while hot process zinc coatings weigh from $1\frac{1}{2}$ ounces minimum to 3 ounces maximum, depending upon the temperature of the bath, and the slowness of removal therefrom giving time for the article to drain off. The following table gives the increase in weight of different articles due to hot galvanizing :

Description of Article.	Weight of Zinc per Square Foot.	Percentage of Increase of Weight.
Thin sheet iron = 0.026 inch No. 22 B.W.G.	1.196 ounces.	18.2
$\frac{5}{16}$-inch plates.....	1.76 "	2.00
4-inch cut nails.....	2.19 "	6.72
$\frac{7}{8}$ inch die bolt and nut	approximately 1.206 ounces.	1.00

Tin is often added to the hot bath for the purpose of obtaining a smoother surface and larger spangles or facets, but it is found to shorten the life of the protective coating considerably. A portion of a zinc coating applied by the hot process was found to be very brittle, breaking when attempts were made to bend it ; the average thickness of the coating was 0.015 inch. An analysis gave the following result :

Tin.....	2.20
Iron	3.78
Arsenic.....	Trace.
Zinc (by difference)	94.02

A small quantity of iron is dissolved from all the articles placed in the molten zinc bath, and a dross is formed amounting in many cases to 25 per cent. of the whole amount of zinc used. This zinc-iron alloy is very brittle, and contains by analysis 6 per cent. of iron, and is used to cast small art ornaments from. A hot galvanizing plant having a bath capacity of 10 × 4 feet × 4 feet 6 inches outside dimensions, and about 1 inch in thickness, will cost $625 and will hold 28 long tons of zinc, which at 4 cents per pound will require $2,500 to fill it. The heating of this mass of metal and its ever changing cold immersions, with the

waste by dross and extra thickness in spots, is a constant source of annoyance and expense.

The cost of an electro-chemical or wet bath Cowper-Coles plant of 6,700 gallons bath, size 30 × 6 feet × 7 feet, will be but slightly more than the hot bath given. There is no dross formed by the use of the Cowper-Coles process, and the zinc coating formed is said to resist the corroding action of a saturated solution of copper sulphate—English Post Office test for telegraph wire—much better than hot galvanized iron wire, as per following table :

Result of Process Test Made on Samples of Charcoal Iron Wire Coated with Zinc by Various Processes.

Process Used to Test the Iron.	Grains of Zinc per Square Foot.	Ounces per Square Foot.	No. of 1-Minute Dips ; Samples Stood without Showing Metallic Copper.
Hot galvanized	648.5	1.48	3
Acid bath $ZnSO_4$	446.4	1.02	4
Cowper-Coles process...	552.64	1.26	5

A Cowper-Coles process bath of a capacity of about 4,000 gallons will treat ship plates 18 feet long, and will require an electrical energy of 2,000 amperes of 5-volt electromotive force.

With equal amounts of zinc per unit of area, the zinc coating put on by the cold process is more resistant to the corroding action of a saturated solution of copper sulphate than is the case with steel coated by the ordinary hot galvanizing process ; or, to put it in another form, articles coated by the cold process should have an equally long life under the same conditions of exposure that hot galvanized articles are exposed to, and with less zinc than would be necessary in the ordinary hot process. The hardness of a zinc surface is a matter of some importance. With this object in view, aluminum has been added from a separate crucible to the molten zinc at the moment of dipping the article to be zinced, so as to form a compound surface of zinco-aluminum, and to reduce the ashes formed from the protective coverings of sal ammoniac, fat, glycerine, etc. The addition of the aluminum also reduces the thickness of the coating applied.

Cold and hot galvanized plates appear to stand abrasion equally well. The thickness of the coating being the same, tests by means of the Schlerometer show : Cold galvanized sheet, 6° ; hot galvanized sheet, 6° ; terne plate, 2° ; tin plate, 2°. The figures represent the load in grams upon a diamond point, just sufficient to cause it to scratch the specimen. The attempts to electro-zinc iron and steel wire for wire standing rigging, bridge or other cables, have not been successful ; it has not been found practical to produce a wire capable of withstanding more than one immersion in a copper sulphate solution.

Both pickling and hot galvanizing reduce the strength, distort and render brittle iron and steel wires of small sections. Zinc fuses at 775° F., and the bath is usually kept at about 1,000° F. Steel wire of high breaking strain has its hardness, and consequently its ultimate tensile strength and elongational efficiency, reduced by drawing of the temper and the formation of an iron-zinc alloy on the surface of the wire, by as much as from 5 to 10 per cent. It is the practice when coating steel wire to keep the bath at as low heat as possible and to run the wire through it at a high rate of speed. Both these operations lead to a waste of zinc by reason of the rapid solidification of the metal on the comparatively cold wire, and consequently the ready breaking or cracking off of the covering metal on bending or twisting it, owing to the difficulty with which molten zinc adheres to the steel except after long contact in the bath. In some cases the wire is wiped between asbestos rubbers as it leaves the bath ; but wire thus treated is found to resist corrosion but a very short time.

The English manufacturers have ceased galvanizing their high grade steel wire that cost some $175 per ton, on account of the great risk of rendering it worthless, which is clearly a disadvantage, although the advisability of protecting the steel is unquestionable, as corrosion is found to be very marked on the inner strands of ropes or cables formed from uncoated wires. The Cowper-Coles or cold galvanizing process is in operation at the works of the Laird Bros., Birkenhead, England, and used for the purpose of zincing the skin plates and frames of the torpedo boats and torpedo boat destroyers built by them for the English Navy.

THE New York City Gas Commission has awarded a contract to the New York and New Jersey Globe Lighting Company for the partial lighting of Central Park by means of naphtha lamps. Under the agreement the Company will maintain 200 lamps, 150 of which are to be distributed along the driveways, the price to be $22 per lamp per year, and the lighting schedule is to be 4,000 hours.

Concrete Construction—Its Practical Application.

By MR. ERNEST L. RANSOME.

The practical application of concrete may be conveniently divided into four divisions—viz., 1st. False work. 2d. Materials. 3d. Tools. 4th. Labor.

The second division can be usefully divided into four sections—viz., A. Cement. B. Aggregates. C. Iron. D. Water.

Division 1.—*False Work.*—Concrete, in respect to false work, is unfortunate in comparison with other masonry, because it not only needs more expensive centering whenever centering is necessrry, but it also usually requires cribbing, whereas other masonry does not.

This characteristic entirely prohibits its use in many cases where in all other respects it would be desirable, and it is therefore an obstacle to the more extended use of this valuable construction that should be minimized as much as possible.

Of late years I have met with considerable success by adopting systems of standard centering and cribbing, which, while not of universal application, are of great use, permitting, as they have done, of the construction of floors and buildings that otherwise could not have been attained ; but as this is of interest to the contractor rather than to the architect, I will not enter into a detailed description thereof.

Great difficulties have often arisen from the swelling of the sheeting of the centering or cribbing, caused by the wood absorbing the moisture of the newly placed concrete. From this cause many arches have been lifted and broken, floors cracked and walls thrown out of line. By using sheeting boards of moderate width, say 6 to 8 inches, and beveling one edge slightly, the boards may be put close together, and when expansion occurs the only effect will be to slightly crush the sharp outer edge of the bevel without lifting or disturbing the concrete abutting or resting upon it, the widest side of such boards being of course placed facing the concrete.

This is such a very inexpensive, simple and unfailing remedy that from its conception I have used it in all cases, and since its use I have never had any trouble from swelling of the timber. Some such device as this is especially necessary in dry climates, also in light constructions, such as floors of but an inch or two in thickness, or hollow walls.

For standard centering or cribs, if of wood, it is advisable to make them of planed lumber. The surface of the wood should be thoroughly coated with common thick kerosene oil before it is used for the first time, and before each subsequent use it should be brushed over afresh with the oil, or else with a paste made of castile soap and water. Fish oil is objectionable, as it is apt to injure the surface of the concrete, and linseed oil is generally too gummy for this purpose.

It may be accepted as a general rule that false work of light sheeting, well braced, is more economical than heavier planks with braces farther apart. I am aware that this is not the usual practice.

The ornamental effect can be much more cheaply produced by recessed than by projected work.

Materials.—Under this head cement, by reason of its greater cost and active qualities, stands out pre-eminent. I will limit my remarks under this subdivision to Portland cement, with the exception of the following observation—viz. :

That where rapidity of construction is not a great object, and aggregates are unusually cheap, by the use of common lime, with or without some of the cheap native cements, properly handled, work of a good quality and astonishing cheapness can be made—1 part of lime to 40 parts of aggregates not being considered too little in some cases.

Portland cement, a giant from its birth, is striding rapidly along in the way of improvement in quality and price, so that formulas of tests that were thought severe a few years ago, would not be considered sufficiently exacting at the present time to insure as first class the cement that would successfully pass them.

The current technical literature teems with methods of testing, so that we can hardly go astray in the selection of a good cement. The three principal requisites for a first-class cement are as follows :

1st. That it sets or hardens without undue expansion or contraction.

2d. That it be sufficiently finely ground.

3d. That its tensile strength be high.

The usual methods of ascertaining these points are :

1st. The cake test. This test is so well known that a description of it here is unnecessary. When time is an object, by the use of hot water the test may be hastened. Under expert supervision the "boiling test" is by many considered superior to the cake test, but the difficulties in the way of carrying it out and some uncertainties in the results that yet linger about this new test, prevent me from advocating its substitution for the older test.

2d. The test for fineness. Ninety per cent. of the cement should pass through a 100-mesh screen having 10,000 holes to the inch. It would be better to use a yet finer screen for testing but for the difficulty of readily obtaining finer screens. The practice of using coarser screens is to be condemned because they pass much that is inert. The screenings should feel soft and silky to the touch. The residue on the screen should be hard, black, angular grains. The economic importance of fine grinding has seldom been exaggerated. It is usually unduly disregarded, yet it has been established beyond reasonable doubt by repeated experiments that the sand-like grains of the cement are perfectly inert and useless. Still, unlike the first qualification, this is an economic question, and the ill effects of coarse grinding, if not apparent in the first test, can be overcome by making due allowance for the coarse portion in proportioning the cement to the aggregate, and then but little harm will follow the use of coarse ground cement in ordinary work.

3d. Tensile strength. This test is usually and best made by the aid of the ordinary testing machine. Several first-class cements will now develop tensile strengths of 600 or 700 pounds per square inch in seven days, and while this may be too high a standard to insist upon, yet the cement that will not furnish a strength of 450 pounds in 7 days, ought not, in my judgment, to be graded as first class, unless it is exceptionally fine ground.

With regard to the aggregates not much has been published. Sufficient interest is not usually taken in these inert materials, which, nevertheless, have a powerful influence upon the character of the concrete, so much so that a good aggregate with a poor cement will sometimes give better results than a good cement with a poor aggregate.

A first-class aggregate should be made of a hard, tough rock, free from clay or dirt, and having a rough surface and sharp angles when broken; it should be so graded, from the finest grains to the largest pieces admissible in the work it is for, as to give, while retaining the largest proportion of large sized pieces, the smallest proportion of voids.

If the aggregate is all of one material the desired aggregation can be determined by weighing a given measure. That proportion which, while retaining the maximum amount of large pieces, weighs the most, is the best.

If, on the other hand, the aggregate is composed of different materials, then that proportion which in a given measure and under the same limitations as just given, will permit of the introduction into the filled measure of the least quantity of water is the best.

In making such tests the larger the measure the better; a round measure is better than a square box, and it should not contain less than 2 cubic feet. The material also ought to be shaken down into the measure. It is desirable, when time will permit, to make these tests with a mixture of 1 of cement to 3 of sand; but ordinarily with cements of equal fineness the relative strength of different brands will remain about the same as under the test with neat cement.

For fireproof work care should also be taken to avoid such aggregates as contain feldspar, and where the possibility of the concrete being subjected to a long continued red heat is sufficiently probable as to be worthy of precautions being taken to meet its effects, limestone also should be rejected from the aggregate.

To those who have studied the matter practically, it is evident that in the large majority of cases the prejudice against the use of the dust and finer particles created in crushing brick or stone is unfounded, and the practice of prohibiting these and substituting therefor ordinary sand is strongly to be condemned. Lieut. Innes found that both limestone dust and ground, burnt clay gave stronger results than the purest sands, and tests and works carried out under my supervision thoroughly corroborate this.

The largest stone does not necessarily make the best aggregate. For instance, finely crushed granite is for some purposes inferior to finely crushed limestone, although as a rule the granite is the harder of the two. One reason for this is not hard to seek. Owing to the brittle quality of granite, in crushing it is not only broken into small pieces, but many of these pieces are so bruised or contused that upon a little pressure being exerted upon them, such, for instance, as can be applied by the finger or thumb, they will crumble. With limestone and many other softer rocks, by reason of their greater toughness and elasticity, this is not the case.

Again, some stones, as quartz and the like, have surfaces of such smoothness that the adhesion of the cement thereto is not so good as that between cement and other stone, such as basaltic lava, sandstones and the like, which, when fractured, present a rough surface. Such stones as these latter usually make first-class aggregate. Broken stone, as a general thing, is a better aggregate than gravel. Sometimes a mixture of the two is preferable to either alone. Usually the use of one or the other has to be determined by the economic side of the question and the local supply. When from such causes gravel is selected, its quality can be greatly improved, at small cost, by running it through a crusher that will break the larger pieces as they pass.

The common practice of limiting the maximum size pieces so that they will pass through a 3-inch ring is, I think, open to question. In massive work, stones much larger may advantageously be used, not, however, if the late fashionable practice of "dry concrete" is adhered to.

The experiments carried out by Mr. Elliott C. Clarke tend to show that the presence of a small amount of clay in the concrete is no detriment to the strength of concrete, even with clay as much as 10 per cent. of the aggregates and cement combined.

In corroboration of this I would instance the Niagara gravel, which, whilst it contains a marked quantity of clay, yet makes most excellent concrete.

Having determined the aggregate, the next important question is, What is the proper proportion of cement to use for any given work?

With first-class materials, in round figures and within the limits of proportions between the cement and the aggregates of from 1 to 4, to 1 to 15, the crushing strength of concrete, when skillfully made, at a month old may be taken as follows in tons per square foot: Multiply the constant number 700 by the number representing the proportion of cement used, and divide it by the relative number representing the amount of aggregate used. For instance, a concrete composed of 1 part of cement to 14 parts of aggregates should, when properly seasoned, have a crushing strength of $\frac{700 \times 1}{14} = 50$ tons; when three months old the strength will have increased some 25 per cent., and when twelve months old it will have increased some 50 per cent.

Under this rule a concrete composed of 1 of cement to 14 of aggregate would be about on a par with good brickwork when a month old, and about 50 per cent. stronger when twelve months old. This rule reduces the strength of the concrete too much as the proportion of aggregate is increased, but it is reasonably correct and quite safe to act upon.

Section C.—Iron.—The tensile strength of concrete is comparatively little, and by reason of the gradual though slight shrinkage that takes place in all concrete structures that age in dry situations, should not be relied upon in any important work.

For giving tensile strength to concrete, all modern workers of note now use iron in some form or other.

Angular iron bars, cold-twisted, commend themselves in many ways, and on this continent they have been more largely used than any other form in concrete-iron construction.

The advantages of this cold-twisting are many. They may be summed up as follows:

1st. The tensile strength of iron is largely increased—viz., from 20 to 50 per cent., dependent upon quality of iron used.

2d. Its elongation under strain is considerably lessened, a very important advantage in concrete-iron construction.

3d. It forms a *continuous* key with the concrete, both longitudinally and also athwart the bar. The effect of the twist is to *grip* the concrete in every direction, and in fireproof flooring and other work where light construction is desired, the importance of this universal key is very great, for it counteracts the tendency which the bar otherwise would have to split the concrete along the line of tension.

4th. The cost of twisting is nominal, and the royalty for its use not prohibitory.

In placing these bars care should be exercised in putting them in position where they will best exert their strength. They should be straight and laid directly in the line of strain. Any deviation from this rule should be such that the tendency to straighten, which invariably occurs upon the application of the strain, will do little or no damage, such a deviation, for instance, as laying the bar of a floor beam with a slight sag in the center. In such a case, when the strain takes place the tendency to straighten would have the effect of thrusting the center of the bar upward against the downward thrust of the load, and it would be harmless. If, on the other hand, the bar was laid crowning in the center, upon the floor being loaded, the tendency of the bar to straighten would be in the same direction as that of the downward thrust of the floor load, and the consequences would be detrimental, if not fatal, to the integrity of the structure.

Concrete is an excellent conservator of iron, Von Emperger states that he knows of a case where iron rods were found perfectly rust free after having been imbedded in concrete below the water level for 40 years. (T. A. V. C. E., Vol. XXXI., p. 447.)

W. G. Triest, Jr., states that a wrench that had been buried in con-

crete 22 years had kept its black metallic surface. (T. A. V. C. E., Vol. XXXI., p. 467.)

Referring to some concrete foundations that I built about 10 years ago, the president of Starr & Co. writes as follows, under date of December 30, 1893: "Though this foundation is on tide land and submerged in salt water more than half way up, there is no rusting or deterioration to the iron. We had occasion to cut through one of the arches and found the iron as stated." A long time ago I imbedded a dozen pieces of hoop iron in as many blocks of concrete, leaving one end of each piece of iron projecting from the surface After years of exposure to sea air, all the exposed iron had rusted away, or so nearly as to leave but a few soft, jagged needles of rust that were readily removed by the hand. In all cases upon cutting into the blocks I found the iron almost as good as new, and from one to two inches from the surface it was invariably so.

Section D.—Water.—The water for mixing should be clear, and by preference soft. If it cannot be obtained of ordinary purity, then due allowance should be made for the impurities by an additional quantity of cement.

Sufficient water should be used to bring the mass when thoroughly mixed into a stiff, sticky, tenacious, viscous condition. An error as to the amount of water that should be used in concrete some years ago crept in the professional practice both of engineers and architects, and with surprising rapidity permeated and revolutionized it. I allude to the erroneous theory that only sufficient water should be used to slightly moisten the mass, and hardly enough to render it cohesive in its uncompacted state.

An error seldom takes the hold this did upon a skilled body of men without some apparent justification. The only justification that I have been able to find after considerable research is the fact that, in making briquettes for testing purposes, the use of a minimum quantity of water gives the best results. From this one little isolated fact the generalization was made that, to produce the best results, concrete should be mixed in like manner. The fatal flaw in this deduction lies here, viz.: that a mixture of cement or of cement and sand, with water, differs radically in conditions when to either of these gravel is added, and differs yet more when broken stone is used.

If cement, or cement and sand, is mixed with a large proportion of water, it cannot be compacted by blows or such pressure as can usually be brought to bear, for the mixture would flow from under the tamper. In the latter case, however, where gravels or broken stone are used, with a larger proportion of water, the concrete can be compacted more intimately and closely than with the minimum quantity, and under all ordinary conditions makes a much better concrete. The only exception to this is where smooth, rounded pebbles only are used with the mortar of the concrete, but this exception does not apply to ordinary gravel and never applies where broken rock is an ingredient. I allude to this at some length, because the error, although on the wane, is still widespread.

Division 3.—Tools.—There is great advantage and economy in mill mixing. Mills can now be obtained at a reasonable figure and should always be used on large works. By their use the cement is more fully utilized, the cost of labor lessened and the work is more uniform and satisfactory in character.

An objection is often made to mill-mixed concrete, viz., that the concrete is injured by overmixing. What is "overmixing?" A very rare *distemper*, this. I have never once met with it, although I have been actively engaged in concrete construction for 35 years. It is never epidemic or fatal, but like vaccination, if present, it would prevent worse and more fatal ailments.

Mr. Spencer Newberry found that a mixture of 1 of cement to three of sand, which when worked for one minute with a trowel developed a tensile strength of 87 pounds in 7 days, developed a strength of 240 pounds in same period after being worked with the trowel for five minute, a remarkable result, surely, and well worthy of consideration.

Contrary to the almost universal opinion, Portland cement is improved by a delay between mixing and placing. I have experimented with several brands of Portland cement and find that they were invariably improved in tensile strength by a delay of from 1 to 4 hours between mixing and placing.

In placing concrete it is preferable to have it of one uniform consistency throughout the mass. In cases, however, where it is required that the face of the work should be of a finer grade, both grades should be carried on simultaneously, the face grade being placed up against the sheeting or mold a little in advance of the backing by means of a trowel or other convenient tool. In more careful work thin strips of iron about 6 inches wide and of any lengths convenient, may be set up on edge in the concrete parallel to and at any desirable distance from the face of the mold. The face concrete should then be inserted between the mold face and the iron while the backing is placed at the other side thereof. As each layer is put in the iron is drawn up a few inches, so that when the concrete is tamped the effect of the tamping is conveyed below the lower edge of the iron, and causes the two grades of the concrete to become thoroughly united and monolithic.

The material should in ordinary cases be placed in thin layers seldom greatly exceeding in depth the length of the largest aggregates used, and these layers should follow one another sufficiently quickly so that one layer does not become stiff or partially set before the next is upon it.

Flat tampers should not be used for massive work except in the first and last layers of the day's work; thin or edge tampers should be employed. Wherever practicable the concrete should be compacted by rolling, in preference to tamping. It is cheaper and much more effective. I am not aware of its being done outside of my own practice, but it is certainly deserving of almost universal use. On large work steam rollers would be excellent.

It may be accepted as an axiom that concrete cannot be too thoroughly compacted, provided the action is not violent enough to bruise or crush the aggregate.

In massive or deep work, as it proceeds through the day, often the working surface becomes richer in mortar, when, and as often as this occurs, the mixture should be changed by adding thereto more of the larger aggregates free from fine dust, sand or gravel, until this fault is remedied. If on the contrary at any time the surface becomes open for lack of mortar, it should be immediately remedied by putting into the mixture a lesser quantity of the larger aggregates and not substituting anything in their place.

In a similar way the amount of water used in the mixings should be regulated, changing to more or less as the working surface appears too stiff or too watery. It should be firm under the tamper or roller and yet the mortar should be viscous and unctuous to the touch.

The quantity required to produce this condition varies greatly, dependent upon the character of the aggregates, whether but slightly or very porous, and upon the age and character of the cement and weather.

Great care should be observed in joining the work of one day to that of the next. The last layer should be thoroughly compacted and left with a slight excess of mortar. It should be finished with a level surface, which at proper time, as soon as sufficiently stiff, should be patted or stippled with a steel float so as to produce a surface studded thickly with little conical knobs. This surface should be kept wet throughout the night, and in the morning immediately before the application of the first layer of fresh concrete it should be covered with a wash consisting of a mixture of equal measures of Portland cement and air-slacked lime, mixed with water to the consistency of thick cream. This covering should be put on in excess and brushed thoroughly back and forth upon the surface so as to insure a close contact therewith, the excess being swept along just ahead of the fresh concrete until all the surface has been covered, when it should be removed.

When in place the concrete should be kept moist for as long a period of time as possible. When one bears in mind that the chemical action which causes the cement to harden can only take place in the presence of moisture, the importance of keeping the work wet is at once apparent. In all concrete construction, excepting subway and other works where the concrete remains permanently moist, provision should be made for the slow but certain shrinkage that takes place in the concrete as it becomes thoroughly dehydrated. The vertical shrinkage will take care of itself, as the weight of the building is in harmony with its movement. The horizontal shrinkage, however, is resisted by the inertia of the structure and the friction of its foundation. There are several ways to direct such shrinkage; that which I have found most feasible is to partially divide the wall at certain intervals, preferably over the windows where there are several in line, and to insert across the division a weathering strip of copper or lead.

Where the appearance of a straight division line on the face of the building would be objectionable, for instance, a wall blocked off into ashlar face, I build this division straight and cause it to coincide with the line of the V recesses of the ashlar, marking in every other course, and I block out in the intermediate courses recesses opposite to the division line, and subsequently fill these recesses with concrete ashlars made and seasoned beforehand. By adopting the pattern of alternate long and short ashlars in every other course with long ashlars only in the immediate course meeting at the center line of the short ashlars above and below them, these separate concrete ashlars may be made small, and the additional cost of their manufacture will be but trifling.

Apart from the question of appearance, some such division of the surface of a concrete wall is advisable for a two-fold reason; some defining line is needed at the juncture of each day's work at least, and by dividing up the surface by deep recesses into small sections, surface cracking is largely avoided.

In reference to this shrinkage of concrete, lest I should have unnecessarily alarmed you, I will state that in a building, the walls of which were 170 feet long and divided thus, it was nearly two years before any apparent shrinkage took place, and now it can hardly be observed by a minute examination of the division joints. No outsider, even though a careful observer, would be likely to perceive any effects of this slight shrinkage when thus controlled.

In situations where it is not possible to make shrinkage joints, by a liberal use of twisted iron shrinkage cracks can often be prevented.

The Resistance of Portland Cement Concrete to the Destroying Action of Fire.—By a misunderstanding, due to a windy interference (Mr. Stone tells me one of my letters was blown out of his office window), I find I am expected to speak on the protection concrete affords iron in case of fire.

There seems to be not so much data on this subject as one would desire. What little there is, however, seems to be in favor of concrete as a fire resistant.

It is generally understood that the artificial stone made with Portland cement concrete withstood the Chicago fire well. Some years ago the blacksmith's shop at the Benecia Arsenal, California, was burned out, leaving the outer walls standing. This was a brick building with granite door sills, freestone belt courses, with window caps and cornice of Portland cement concrete. I examined the ruins carefully. The granite was spoiled badly and broken into several pieces; the freestone was badly broken and injured; the brickwork was burnt out in the joints in many places, rendering the walls unsuitable, many of the bricks also being spoiled, whilst the concrete window heads, which had probably to bear the brunt of the fire on the outside, were but little injured; the surfaces had softened a little and were badly discolored, but they remained whole and strong.

Concrete bricks, made of well-burnt clinker and lime by a process which converts the lime into a silicate of lime, thereby making it resemble a Portland cement in character, withstand the action of a hot fire and the subsequent sudden cooling by water better than any burnt brick, either common pressed or firebrick, that I could obtain in San Francisco, and I presume the same relative result would be obtained from most of the bricks of the several States.

I have repeatedly made the tests so severe that every burnt brick in the dozen or so tested at a time broke into two or more pieces, whilst under the same test the concrete bricks, beyond discoloring slightly, showed no change.

The Thermic Expansion of Portland Cement.—Bonnican Bonnicean is quoted as giving the expansion of Portland cement at 0.00000143 for 1 celsius, and iron is given at 0.00000145, which is practically the same.

Hyatt corroborates this in some careful experiments he made with loaded floors submitted to fire, in which the concrete-iron construction bore a red heat for several hours without injury.

Throughout Europe, I believe, hollow tile construction is almost unknown. Concrete floors are commonly used in fireproof buildings. The result of tests undertaken in Germany under government supervision to ascertain the relative value of the ordinary building material, including brickwork, places concrete at the head of the list as the best fire resistant.

If due regard is paid to the aggregate used, so that feldspar is avoided, and limestone also, where the structure is liable to prolonged hot fire, I think it will be found that Portland cement concrete is an excellent fire resistant.

How an Electric Current Introduced Gas into an Electric Culvert.

[Communicated by Mr. S. W. Durkin, of Southampton, at a Meeting of the Southern District Association, England.]

In introducing this subject, it will be as well to take a retrospective glance at the work carried out in Southampton by the contractors for the Electric Light and Power Company, under their license. Prior to the making of the culvert for containing the electric mains, a very amiable young man waited upon me to ascertain the depth of the gas mains and service pipes, and was desirous that we should, where necessary, have them put in such a position as not to interfere with their operations. This, he was informed, could be done at his employers' expense, provided that the usual conditions could be obtained of having a proper fall from premises supplied with gas back to the gas main. However, we were not called upon to do much in this line. But we insisted that, where necessary, our pipes should be properly insulated. This the contractors did in their own way, especially where the service pipes came close up to the floor of the culvert. But with how much success, in one instance at least, the sequel will show. I may state that during the progress of this work every gas service was examined, and, where necessary, entirely renewed, so far as the electric culvert went. The Electric Company have now been supplying current for several years from a low tension plant, and it appears to be a very good example of central station lighting.

Up till October 16 last, the two underground systems for supplying each kind of artificial light had gone on without molesting each other, or disturbing persons or property. On the evening of the 15th of October, however, I am informed that there was a leakage on one section of the electric mains. On the following morning, the electric light inspector went into the High street to localize it. After opening up one or two of their covers, the man detected gas, and soon after telephoned to the gas works for our inspector to come to his assistance. The latter, on arriving at the scene of action, had the whole of the traps over the section opened up; and as they went down the street, gas was scented more and more strongly, until they came very near to what proved to be the source of the mischief. I was sent for; and the question was what to do, in the emergency, to prevent any mishap and to stop the gas leakage.

The gas main was under the kerb, so that the service pipes were short in length. These latter I determined to strip and examine. Another precaution was to isolate the main. But, fortunately, this became unnecessary, as the second service we opened, and which passed under the floor of the culvert, revealed the cause of the mischief.

The electric mains, as previously stated, are laid for the low-tension system, and are strained up to bridges placed at intervals across the culvert. These mains are formed of copper bars about 1 inch by ¼ inch in section. The gas service was supposed to be insulated by a stoneware tile, semicircular in section, imbedded in Portland cement rendering on each side; but the center was above the culvert floor. This insulation might have continued had the copper main kept in its original position; but, from some cause, it sagged (perhaps from a holdfast breaking), and rested on the insulating tile. Then the electric current, anxious to leave its copper-bound lodging, made a crater-shaped hole through the tile. [The fused portion of the tile and the perforated service pipe were exhibited. The latter was evidently in good condition before the accident, and Mr. Durkin mentioned that it had only been in use something like three years.] The opening in the service pipe is about 0.7 inch in area, and of irregular form.

The copper main was fused and fell asunder, dropping far enough away to prevent further short circuiting. There was evidence of the gas having been lighted, there being a deposit of carbon found on the stone cover of the culvert. But for some reason the flame went out, the presumption is that it was for want of air to support combustion. It was very satisfactory that no explosion ensued. At the same time, this incident shows the culvert system to be one likely to lead to disaster when in close proximity to gas mains in public thoroughfares. In this instance, there were 360 yards of culvert charged with gas. The damage was soon made good by those concerned, and a new form of insulator inserted, which, I trust, will prove more reliable than its predecessor. I leave my hearers to draw their own conclusions on the whole matter.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. H. N. Bigelow, Treasurer of the Clinton (Mass.) Gas Light Company, under authorization of the proprietors, on the 10th inst., issued the following notice to the residents:

"Office Clinton Gas Company,
"Clinton, Mass., Dec. 10, 1894.

"Beginning January 1, 1895, the following prices will be charged by this Company for gas consumed after that date: For lighting purposes, $2 per 1,000 cubic feet; for gas stoves, $1.60 per 1,000 cubic feet. A discount of 5 per cent. will be made on all gas bills that are paid at this office on or before the 10th day of the month they are due. The date of discount will be strictly observed. Special rates for large consumers may be arranged upon application at the office of the Company. Office hours: 9 to 12 A.M.; 2 to 5 P.M."

These reductions are to be made from the current rates of $2.50 per 1,000 cubic feet, gross, for illuminating purposes, with 10 per cent. off

for payment within 10 days, and $1.75 per 1,000 cubic feet, net, for cooking and heating purposes. The Company, according to the last report of its affairs to the State Board of Gas and Electric Light Commissioners (1892-3), received $2.15 per 1,000 cubic feet. Coal gas is supplied, and the last examination of the same (made by the State Inspector on November 21st) for candle power and purity, showed this result: Candle power, 17.7; sulphur, grains per 100 cubic feet, 9.1; ammonia, grains per 100 cubic feet, 1.0. The Company's business is steadily increasing, and Treasurer Bigelow intends to keep it so.

THE Hazelton Boiler Company, of New York city, is now erecting a 300-horse power "Porcupine" boiler in the plant of the Mutual Fuel Gas Company, of Chicago, Ills., which is the fourth large boiler of that type erected in said plant. The Hazelton Company is also erecting several large boilers in the Calf Pasture Station of the Boston (Mass.) Gas Light Company, and we also understand that it is engaged in manufacturing several large plants of boilers for other industries, some of which equipments are intended for sugar plantations. The Company's President, Mr. E. S. T. Kennedy, is to be congratulated upon the success of his administration, which has always been characterized by honest, straightforward, manly dealing.

THE new gas plant of the Parker process type, recently completed and put in operation at Martinsville, Ind., is said to be giving unqualified satisfaction to the operators thereof and to those who use its product as well. A 24-candle power gas is being furnished, and many former users of incandescent electric lighting are now trying gas. Several dozen cooking ranges and heating stoves are supplied from the Company's mains. Although the works have been in operation only one month the output is now fully up to 25,000 cubic feet per day. The rates are: For illuminating purposes, $1.25 per 1,000 cubic feet; for heating and cooking purposes, 75 cents.

AT the annual meeting of the shareholders of the Fresno (Cal.) Gas and Electric Light Company, which was held in the Farmers' Bank building, Fresno, on the afternoon of last Friday, no change was made in the executive management.

SUPT. E. H. JENKINS, of the Gas Light Company of Columbus, Ga., recently placed one or more Welsbach lamps for outdoor lighting on the busiest and most frequented section of 12th street and lower Broad street in that city, for the purpose of showing what could be accomplished in the way indicated. The experiment and illustration were of such force that the City Fathers, in their call for proposals for the publighting for 1895, inserted the following in the specifications: "* * * For furnishing gas or incandescent lights for bridge, guard rooms, engine houses, market, etc.; also for furnishing——number of street lights in various sections of the city."

EARLY this month the Committee on Street Lights, of Newport, R. I., held a very interesting session. There were present Superintendent Magner and Mr. G. B. Reynolds, of the Newport Illuminating Company, Mr. Garnett and Capt. Lee, of the Globe Gas Light Company, and others. The members of the committee referred to the general complaint that the city is not securing what it is paying for in the way of street lighting, and asked Mr. Garnett (who, by the way, is a police captain) to tell what he knew about the matter. The captain explained how the police tried to keep track of the lights and report all that fail to burn, with a record of the time. He also said that if the fluid lights burned until midnight no account was taken after that time. At the electric light station there is a dial to show the intensity of the current. This always appeared to be the same, though what it meant he did not know. Mr. Magner said the Electric Light Company had the same machinery and better carbons than were formerly used, and that the street lighting must be equal to their old-time standard, as the "candle power cannot run above or below the standard of 2,000." Mr. Reynolds thought that the "growing weakness of the human eyes was what made the people think the lights were getting poor." One of the committee quoted a citizen who, when the electric lights were first put in could read the newspapers in his home by their light, and now the light is so poor that "his daughter, with much better eyesight," is unable to read even the headings of the articles. There was much talk on both sides, and the Electric Light Company was given to understand that, in the opinion of the committee, the city is not receiving the light it is paying for, or anything near it.

THE resolution recommended by the Joint Committee on Municipal Lighting, Cambridge, Mass., averring that it is expedient for the city to purchase the Cambridge Electric Light Company's plant, has been unanimously adopted by the City Council. The resolution also goes before the next City Council, and if adopted by that body will be acted upon by the people in the municipal election in 1896.

SOME time ago the itinerant meter inspecting firm of McAuley, Noon & Co., made their appearance in Canton, Illinois, and offered to inspect the meter of any consumer of gas for a uniform fee of $2.50 "per inspection." They were not long at the work when the Peoples' Gas and Electric Light Company applied for an injunction restraining the itinerants from interfering with its property, which was issued at once in a temporary form. The itinerants subsequently appealed to Judge Hemenover to dissolve the injunction, who, after close consideration of the case, refused the complainants' prayer. In effect, Judge Hemenover said that the consent of the consumer is not sufficient to authorize the testing by an "expert" or any other person, of the measures or weights of a gas company or coal dealer or other vendor. If the defendants, granting them to be experts, might continue their inspection without the permission of the company which owns the meters, and without appointment according to law, then so might a multitude of pretended experts, who might be both incompetent and dishonest as well as irresponsible. In the opinion of the Court, no vendor was compelled to the overhauling or tinkering of his weights or measures, excepting at the hands of a public official, appointed as provided by the law, and under oath and bond to the faithful performance of his duties. The Court was powerless to appoint such inspector, but plainly intimated that the City Council ought to at once name such an official. In the absence of such authorized, responsible, legal inspection, the only remedy the purchaser has, if he believes himself defrauded, is to sue for damages, or let himself be sued in a rendered bill and compel the vendor to prove in court the correctness of his measure.

MR. WILLIAM H. J. BODINE, a Director in the Richmond County, Staten Island Gas Company, died at his home in West Brighton, S. I., on the afternoon of the 9th inst. Deceased was born in Castleton, S. I., February 4th, 1821, and was prominent for over half a century in the business, political, religious and social affairs of Richmond County. For 6 years he was President of the Board of Trustees of the village of New Brighton, which had been incorporated by himself, Francis G. Shaw, Augustus Prentice and James Simonson. Interment was made in the Moravian Cemetery.

THE Yonkers Gas Company has secured a contract for the public lighting of Woodlawn, N. Y.

THE Berlin Iron Bridge Company, of East Berlin, Conn., is building a new roof for the gas works at the Massachusetts Reformatory, Concord, Mass.

MR. J. B. C. SHIPMAN has been appointed Inspector of gas and electric lights at Washington, D. C.

A BILL is before the Alabama Legislature which proposes to empower the authorities of Eufaula to take over the local gas and electric plants (and the water system as well) and operate the same on public account.

AT the last meeting of the Danville (Ky.) City Council a contract for the public lighting of that place by means of gas lamps was awarded to the Danville Gas Light Company. The price agreed on was $20 per lamp per annum, a moontable to be followed; and it was further stipulated that if at any time during the life of the contract (it is to run for 5 years) the number of lamps employed should aggregate 100, the price per lamp is to be reduced to $19.50. Superintendent Brown is very well satisfied over the share of business secured by the Company in 1894.

SOME weeks ago we reported the arrest, and subsequent release on bail, of a man named McDonald, a hotel keeper of Towson, a suburb of Baltimore, who was charged by the Consolidated Gas Company, of Baltimore, with illegally using its gas by means of a bye-passed meter. His case came up for trial something over a week ago, and the jury that considered it rendered a verdict of guilty.

THE Board of Gas and Electric Light Commissioners recently delivered an opinion on the petition of the Boston Electric Light Company for the right to issue additional bonds in the sum of $900,000. The Commissioners find in favor of issuing $660,000 of bonds, of which amount $300,000 is for the purpose of refunding an equal mortgage and $360,000 is to meet the expenditure to be incurred in the construction of

underground conduits and the placing of wires therein. The Company also desired the refused $240,000 for the purpose of taking up a floating debt of equal amount. The Board, in explaining the findings relating to the last named amount, says: "Floating debt, representing the cost of the new plant needed to take the place of that which had become worn out and useless, is essentially a part of the expense of carrying on the business and should be provided for, if possible, out of the earnings. The profits of the Company have been and are likely to continue to be ample to pay a fair dividend and to extinguish the debt. Under such conditions the Board does not believe that the interests of the Company require that the debt be funded by the issue of bonds, as requested. Capital stock has no claim upon the earnings precedent to those of creditors, and not to be governed by this fact in the application of earnings is to endanger the well-being of the stock itself. If, for the early removal of this indebtedness, it shall be deemed advisable to temporarily reduce the present dividends, such a course will be likely to add to the ultimate value of the stock."

THE Sintz Gas Engine Company, of Grand Rapids, Mich., has voted to increase its capital stock to $100,000, from $30,000.

THE Poughkeepsie (N.Y.) Gas Light Company has been awarded the contract for the lighting of the jail and court house, at its bid of $466. The contract is for one year. The local electric company's bid was $525. Lessee Tracy is developing remarkable powers as a diplomat, for no matter whether Republicans or Democrats are in control of Poughkeepsie's affairs, he manages to turn out all right.

THE reorganization proceedings in the matter of the foreclosure of the belongings of the Schenectady (N. Y.) Gas Light Company have been completed.

THE project of starting a gas works at Revere, Mass., is again in evidence. This place (which is a noted beach resort, about 4 miles northeast of Boston) ought to be able to return a fair interest on money fairly invested in a gas plant up to its needs.

THE Berlin Iron Bridge Company, of East Berlin, Conn., will furnish the iron work for the new office building of the Pope Manufacturing Company, of Hartford, Conn.

THE New Haven (Conn.) Gas Light Company has offered to light the public gas lamps in that city for the sum of $21 per lamp per annum, on an all-night schedule, provided the life of the contract is fixed for three years. This is a concession of $2 per lamp from the existing rate, and it is likely the Council will declare in favor of accepting the proposition.

THE proprietors of the Fulton (N. Y.) Gas Company have applied for and received permission to extend their mains to the adjoining borough of Oswego Falls. The Oswego river divides the places named, and both are connected by two iron bridges.

"E. W. P.," writing to the JOURNAL under date of the 19th inst, says: "On Saturday, December 15th, a large party gathered at the West Shore Railroad ferry slip, foot of Franklin street, N. Y., by invitation of Mr. A. A. Forman, President of the Haverstraw (N. Y.) Light and Fuel Gas Company, to inspect the new plant of the Company at Haverstraw. Several ladies were in the party, and the gentlemen who made the journey included such well known gas men as Col. F. S. Benson, J. H. Jordan, A. D. Cressler, C. M. Higgins, W. P. Elliott, C. C. Stevens, and many others. A special car was provided for the accommodation of the party, and the time passed so swiftly that almost before the majority of the guests were aware of it the train came to a halt at Haverstraw village. Carriages were in waiting to transfer the party to the works, which are located about midway of the railroad and the Hudson river. The plant was erected by the Kerr Murray Manufacturing Company, of Fort Wayne, Ind., and the workmanship throughout gave evidence of the acknowledged skill of Mr. Cressler's people, and is in fact beyond anything other than favorable comment. Some difficulty was experienced with the new machinery in starting up, but the hitches were not of moment, and in the end all worked smoothly and to the entire satisfaction of those most deeply interested. The visiting engineers were somewhat disappointed in the development of the process for the manufacture of gas, as they came prepared to look into some novelty of method or practice, but the critical inspectors soon realized that the system was but another modification of the Lowe, a generator, carbureter and superheater being contained within one shell, the variation from the Lowe standard being only in respect of form, as to the proportion and as to the distance travelled by the gases. The first chamber is about 5 feet by 5 feet, with square corners, and about 12 feet high, with side charging door and shaking grate, the air and steam inlets being below. The carbureter is filled with firebrick checkerwork, and has air inlets on the side; the oil is admitted through 3 nozzles on the top. The superheater is about 20 feet high, and is divided vertically by 2 deflectors into flues or channels, in such manner as to cause the gases to travel vertically three times the height before reaching the gas outlet. On the outside of the casing there is an oil heater, arranged to pass the hot gas from the apparatus through a chamber filled with horizontal pipes, through which the oil is forced at high pressure during the run. The gas passes from each set (of which there are two), through a washer or seal box, with one dip pipe and outlet, thence through one scrubber to the holder. It is proposed by the officers of the Company to distribute the gas from the holder to the purifiers and station meter, then through the governor to the street mains. The Company has about 7 miles of street mains in the ground, and about 300 consumers have applied for services. The latter are being put in as rapidly as possible, at the expense of the consumer. Having seen several runs made, averaging a production of about 3,000 cubic feet per run, which seemed to take up about 30 gallons of oil and naphtha mixed to the run, the guests were invited to a lunch in 'Inspection Hall,' which is located over the meter room and offices of the works. Later in the evening an elaborate supper was served at the United States Hotel to those who had the time to remain over. The party returned to the city, arriving at an early hour, and it cannot be truthfully gainsaid that the 'breaking in' of the new plant was other than satisfactory."

A RECENT issue of the Washington (D. C.) *Post* contained the following: "A sub-committee of Senate District Committee, consisting of Senators Hunton, Faulkner and McMillan, gave a hearing on the 10th inst. on the bill which passed the House last session fixing the price of gas at $1 per 1,000 cubic feet. The chief spokesman was Mr. W. C. Dodge, who said that 50 bills had been introduced in Congress for the formation of new gas companies, but not one of them had ever passed. He was not disposed to find fault with this condition of affairs, as if a new company was formed the streets would be torn up and a great disturbance made until the old Company bought up the new one, and then the consumers of gas would be taxed to pay the profits on an increased capital stock. He did think, however, that the present Company ought to be made to furnish gas at $1 per 1,000, and cited figures to prove that it could be done with profit to the Company. He quoted liberally from the report of the Spooner investigation, in 1888, to show that the Company was making enormous profits; that it was now paying 10 per cent. on stock that had been increased to $2,500,000, whereas only a part of that sum had been actually paid out. Mr. Faulkner asked a good many questions, and Mr. McMillan said that the people of Detroit only paid $1 per 1,000 for their gas, and when the consumption increased the price was to go down to 90 cents. Mr. Evan H. Tucker, President of the Northeast Washington Association, made a plea for cheaper gas. He said that the surplus of the Company showed that they could give gas at $1 per 1,000 and still pay 10 per cent. on their stock. The subcommittee took the bill under advisement."

MR. WILLIAM H. HARRIS, whose queer gas making process was thoroughly exploited in our columns something over a year ago, has come to grief. In fact, it is likely he will have to stand trial in more than one instance for false representations, one case in particular being that emanating from Mr. Charles F. Blandin, of New York City, who seeks to recover money put by him into the enterprise known as the General Electric Gas and Iron Company, incorporated under the laws of New Jersey. Mr. Blandin avers that the representations made by Harris respecting the Company were grossly untrue.

WILLIAM MOLINEAUX and R. W. Chappell, who are said to be the responsible parties interested in the Electrical Construction Company, of No. 57 Walnut street, Kansas City, Mo., were recently arrested, at the instance of Mr. Geo. S. Clark, Manager of the Kansas City Gas Light and Coke Company, who accused them of stealing the Company's gas. Defendants had been consumers of gas in the regular way, but, failing to pay their bills, their meter was removed. Feeling the need of gas, however, the members of the "Electrical Construction Company" just "hitched on" to the Gas Company's street service, hence their plight.

THE Citizens Gas Light Company, of Wakefield, Mass., has arranged to build a plant for the supply of gas to the residents of Stoneham. This is the Company whose properties at Wakefield were sold to the local authorities, who are now carrying on the business for public account.

The Market for Gas Securities.

Animation characterized the dealings in the city gas shares during the week, the features being sharp rises in Consolidated, New York and East River common and Equitable. Consolidated scored a net advance of 3⅝ points in the bid price, which was returned in to-day's opening at 132⅝. New York and East River common is 36 bid, and Equitable is bid for at 184. The increase in all is attributed to the fact that an understanding is pretty well assured between prominent interests in the city Companies, and that certain large holders of Consolidated have been dipping into East River common quite extensively. If this is so, and we believe it is, only one conclusion can be drawn, which conclusion is that city gas shares are purchases at the ruling figures. Standard preferred is strong at 86½ to 90, and it ought to be at par, for the Company is now a permanent certainty as a dividend earner. Although the current dividend is at the rate of 4 per cent. per annum, there is not much secret respecting the fact that the earnings are more than equivalent to a 6 per cent. basis. The common, of Standard, at 40 to 45, is a purchase.

Brooklyn shares are bathed in the mellowness resulting from the illumination of peace, although we imagine things are about to go rather hard with some of the "irregulars" connected with the Equity securities. Chicago gas is weak and wobbly, but wobbly and all as it looks, it is cheap at current rates. Bay State is weak and lower, and Lacledes are strong.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks,

35 Wall St., New York City.

December 24.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	132⅜	133
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	184	187
" Bonds	1,000,000	—	107½	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	155	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	40	41
Preferred	5,000,000	100	86½	90
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	120	—
Citizens	1,200,000	20	60	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	175	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	85	—
" Bonds (7's)	368,000	—	100	—
(6's)	94,000	—	98	100
Metropolitan	870,000	100	160	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	200	—
N. Y. & East River Gas				
Com	5,000,000	100	36	38
Preferred	2,000,000		47	49
Bonds	3,500,000	100	88½	89¼
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	175	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	20½	21
Income Bonds	2,000,000	1000	44	45
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Chicago Gas Company.	25,000,000	100	71⅛	71¼
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	93	93½
Consumers Gas Light Co., Jersey City	2,000,000	100	72	—
Bonds	600,000	1000	95	98

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A Situation as Superintendent of a Gas Works

By a sober, energetic young man. Can furnish best of references. Experienced in construction of gas and water works, and in the construction and operation of Gas, Water and Electric Light Plants. Competent in any or all of the different lines, also in office work. Would accept position as Assistant Supt. of large plant. No objection to location. Address

1019-2 "OHIO," care this Journal.

POSITION WANTED

As Superintendent of Gas Works.

Twenty years' experience in every branch of the business—manufacturing, construction, mechanical and clerical. Have made the stove trade a specialty the past five years. Can also manage Electric Plant. Best of references as to ability from former and present employers, and well-known gas engineers. Best of reasons for a change. Address

1018-4 "M. L. S.," care this Journal.

Gas Stock Wanted.

The undersigned is willing to buy a limited amount of Stock of the United Gas Improvement Company, of Philadelphia, if the price is not too high. Address, stating amount and lowest price that will be accepted,

1020-1 "A. B C.," care this Journal.

MANUFACTURER's' AGENCY.

A salesman and general office man of 25 years' experience, energetic, capable and reliable, and accustomed to handling specialties, desires to represent a manufacturer from Jan. 1st. Either wrought iron pipe, or supplies for gas, steam, water, and oil; or a line of gas cookers and heaters, oil stoves, etc. Large acquaintance among jobbers, retailers and consumers. All references. Address, "L. S.," care this Journal.

1018-2

Coal Tar For Sale.

The Lebanon (Pa.) Gas Company will receive bids for their Coal Tar Product of 1895, on cars, in barrels, at Lebanon. Making gas under old process, from best Westmoreland coal. The product will amount to about 250 barrels, of not less than 45 gallons each. Bids will be opened at 10 P.M. of January 1, 1895.

1020-2 JOHN W. MISH, Treas.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

David Leavitt Hough,

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Investment Property Appraiser, Consulting and Contracting Engineer.

Extensions to Existing Gas Plants and Initial Plants Designed.

Bids obtained, checked and tabulated, ready for Board or Commtttee meetings. *Work followed at the Shops to secure Proper Attention and Speed, and Inspected during Erection.*

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Consulting and Contracting Gas Engineer.

Estimates, Plans and Specifications for New Works (Coal or Water Gas), and for Extensions or Alterations.

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Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

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CHATTANOOGA, TENN.

MOSES G. WILDER,

Mechanical Engineer,

816-822 Cherry St., Phila., Pa.

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Gas Governors,

Governor Gas Burners,

Gas Cocks and Fittings,

In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters.* The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

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The

Wilke China Kiln.

For Firing Decorated China with Illuminating Gas.

AWARDED THE HIGHEST HONORS, MEDALS AND DIPLOMAS AT THE WORLD'S COLUMBIAN EXPOSITION.

Many Valuable Improvements added to this Kiln in the Last Year.

Not a Toy, but a Practical Kiln.

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Guaranteed to fire China successfu'ly, and without any discoloration from fuel used.

Thousands in use, and not a single failure.

Full directions furnished with each Kiln sold by which any amateur can fire it without any previous knowledge of this branch of the work. Send for descriptive circular. Address

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1894 DIRECTORY 1894

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Price, - - - - - - - - - $5.00.

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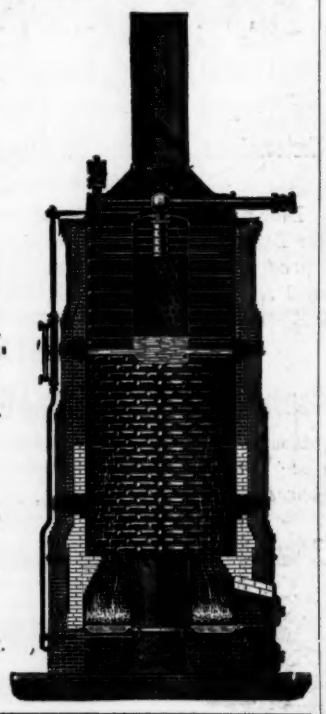
THE HAZELTON OR PORCUPINE BOILER.

Is Superior to All Others in

Economy, Safety, Durability,
Efficiency, Capacity,
Quality of Steam Produced,
Combustion of Fuel,
Accessibility for Internal and
External Inspection and Cleaning.



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German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,

Stettin "Anchor" & "Eagle" Brand Portland Cement

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For Gas Purification.

Analysis, Samples and Particulars on Application.

THE CHEMISTRY OF ILLUMINATING GAS.

By NORTON H. HUMPHRYS. Price, $2.40.

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Used and recommended by New York Coal Tar Chemical Co., Mica Roofing Co., Philadelphia Gas Works, S. E. Barrett Mfg. Co., M. Ehrett, Jr., & Co., etc. *Write for Circulars.*

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Gas Stoves,

PARLOR GRATES and RADIATORS, ASBESTOS BACK and ILLUMINATING FLAME STOVES.

Twelve new Heaters of beautiful design and finish added to our already large line for 1895, swelling the number of Reliable Heaters to

48 Sizes and 106 Styles.

Compare this number with any other two lines of Heaters on the market. Manufactured in all known styles and sizes, ranging in price from $4.00 to $26.00, and in finish from a plain iron to a full nickel or brass plated Stove. **OUR NEW BRILLIANT RELIABLE No. 849** is by far the most beautiful Cylinder Stove ever offered the public.

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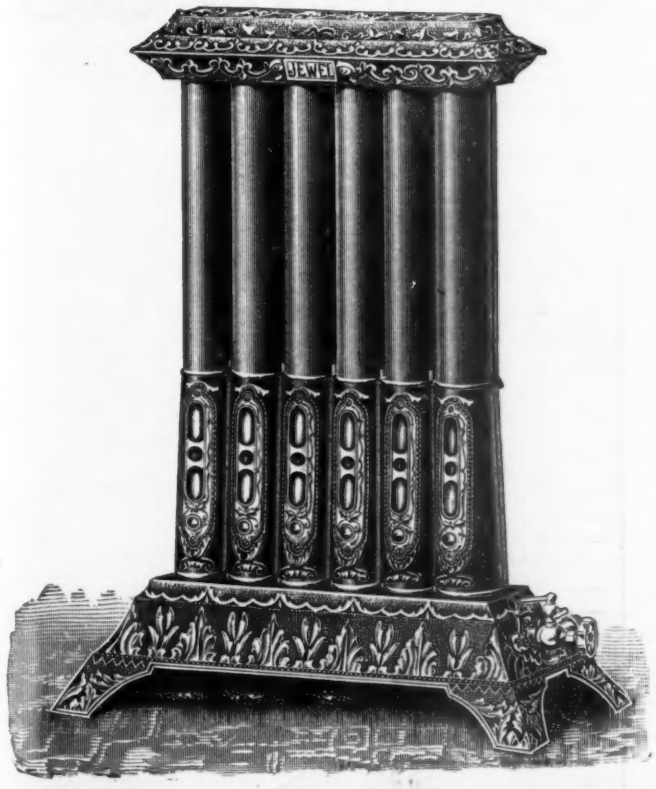
Sole Manufacturers,

Cleveland, Ohio.

JEWEL GAS RADIATORS.



The Perfect Room Heaters.

If these Radiators were simply a duplication of what has been done, they would be worth but a passing notice.

One Continuous Tube
Instead of a Single Tube Construction.

This gives greater burner capacity.

Central Draught Tubes.

This permits chimney connection, without extra cost in fuel.

All Parts Near Burners are Cast Iron.

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Heat Your House with Gas!

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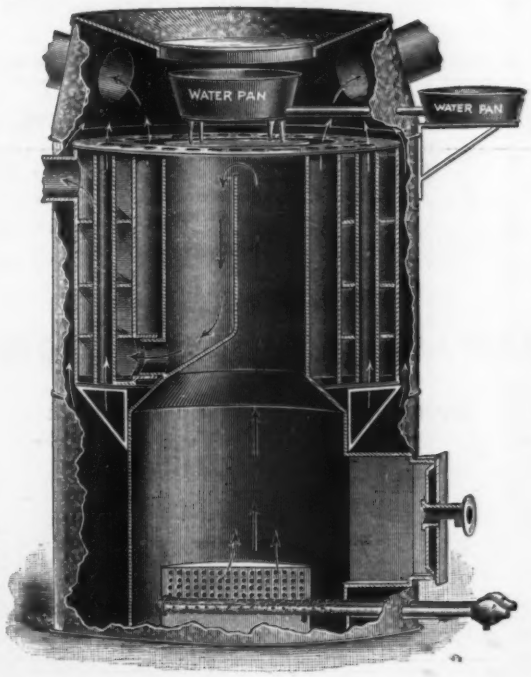

No Smoke. No Odor.

No Labor.

No Waste. No Dust.

No Ashes. No Noise.

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Fully Guaranteed.

	Capacity.		Price.
No. 20	10,000 to	20,000	$70.00
" 24	20,000 to	40,000	80.00
" 28	40,000 to	75,000	90.00
" 32	75,000 to	100,000	100.00

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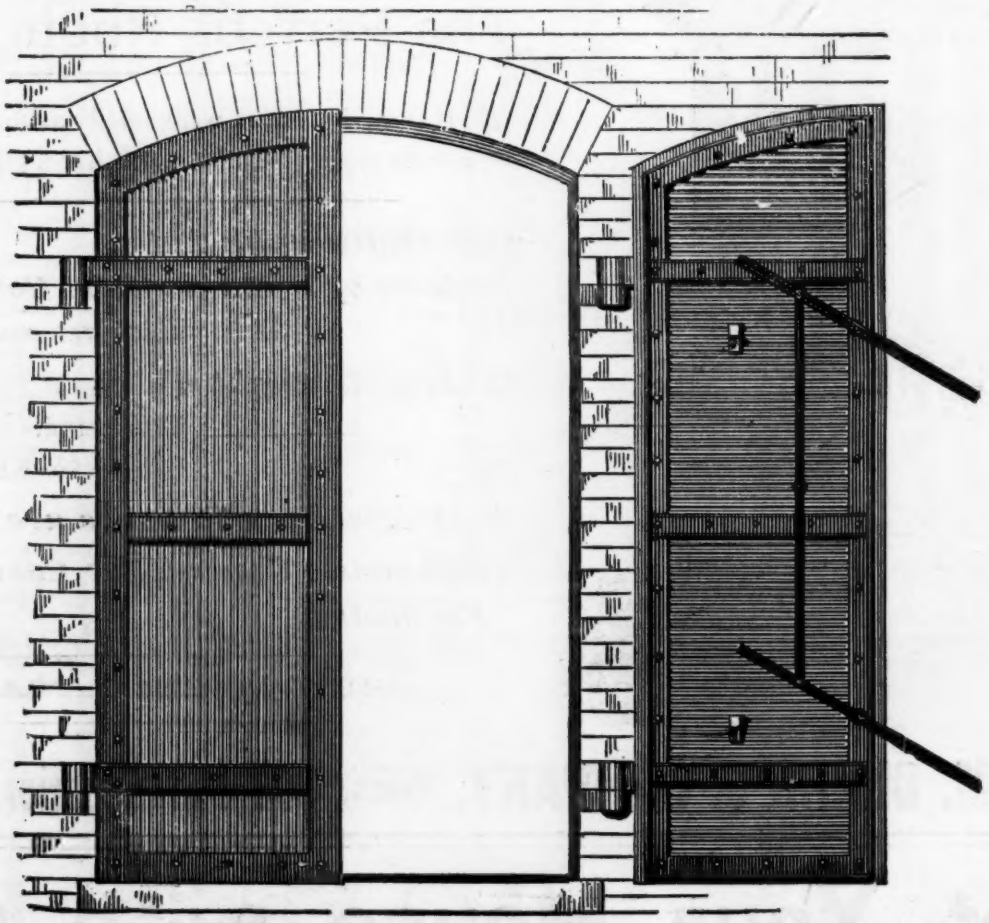

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WATER GAS PLANT A SPECIALTY.
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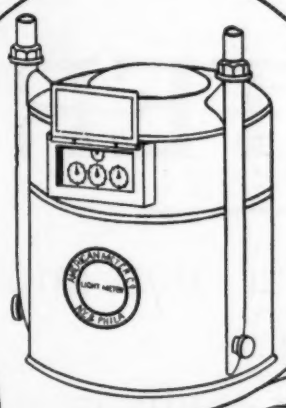
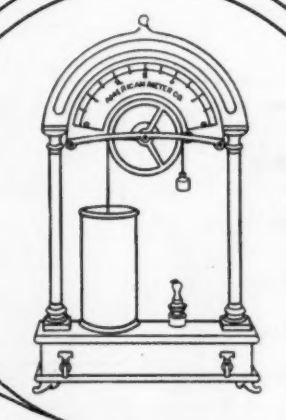
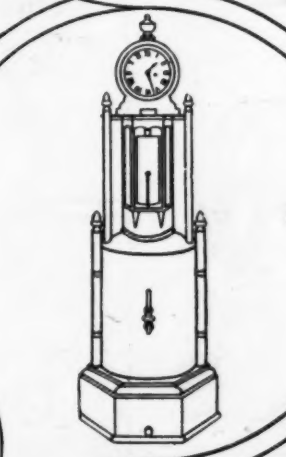
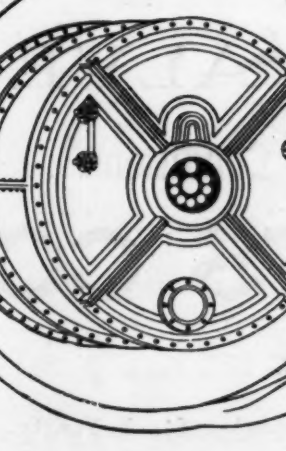








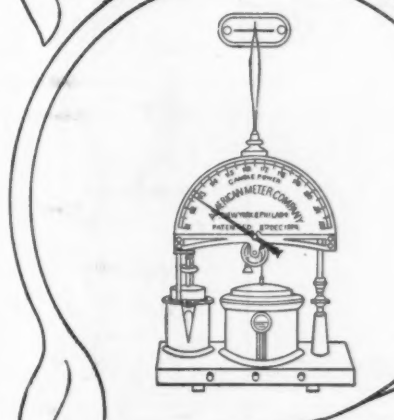
PUBLIC LIGHTING TABLE.

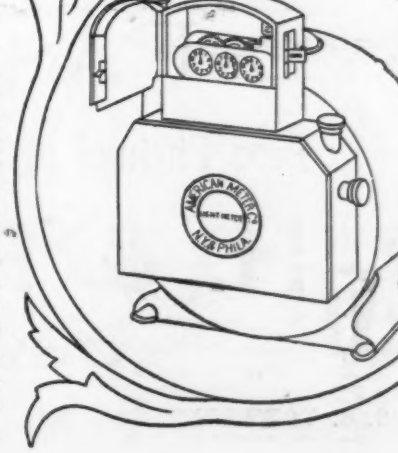
JANUARY, 1895.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	9.10 PM	6.20 AM	4.30	6.30
Wed.	2	10.10	6.20	4.30	6.30
Thu.	3	11.10 FQ	6.20	4.30	6.30
Fri.	4	12.10 AM	6.20	4.30	6.30
Sat.	5	1.20	6.20	4.30	6.30
Sun.	6	2.30	6.20	4.30	6.30
Mon.	7	3.50	6.20	4.30	6.30
Tue.	8	5.00	6.20	4.40	6.30
Wed.	9	No L.	No L.	4.40	6.30
Thu.	10	No L. FM	No L.	4.40	6.30
Fri.	11	No L.	No L.	4.40	6.30
Sat.	12	5.30 PM	7.40 PM	4.40	6.30
Sun.	13	5.30	9.00	4.40	6.30
Mon.	14	5.30	10.20	4.40	6.30
Tue.	15	5.30	11.30	4.50	6.25
Wed.	16	5.30	12.40	4.50	6.25
Thu.	17	5.30 LQ	1.50 AM	4.50	6.25
Fri.	18	5.30	3.00	4.50	6.25
Sat.	19	5.30	4.10	4.50	6.25
Sun.	20	5.40	5.20	4.50	6.25
Mon.	21	5.40	6.10	4.50	6.25
Tue.	22	5.40	6.10	5.00	6.25
Wed.	23	5.40	6.10	5.00	6.25
Thu.	24	5.40	6.10	5.00	6.25
Fri.	25	5.40 NM	6.10	5.00	6.25
Sat.	26	5.40	6.10	5.00	6.25
Sun.	27	5.40	6.10	5.00	6.25
Mon.	28	5.40	6.10	5.00	6.25
Tue.	29	5.40	6.10	5.05	6.15
Wed	30	9.00	6.10	5.05	6.15
Thu.	31	10.00	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45





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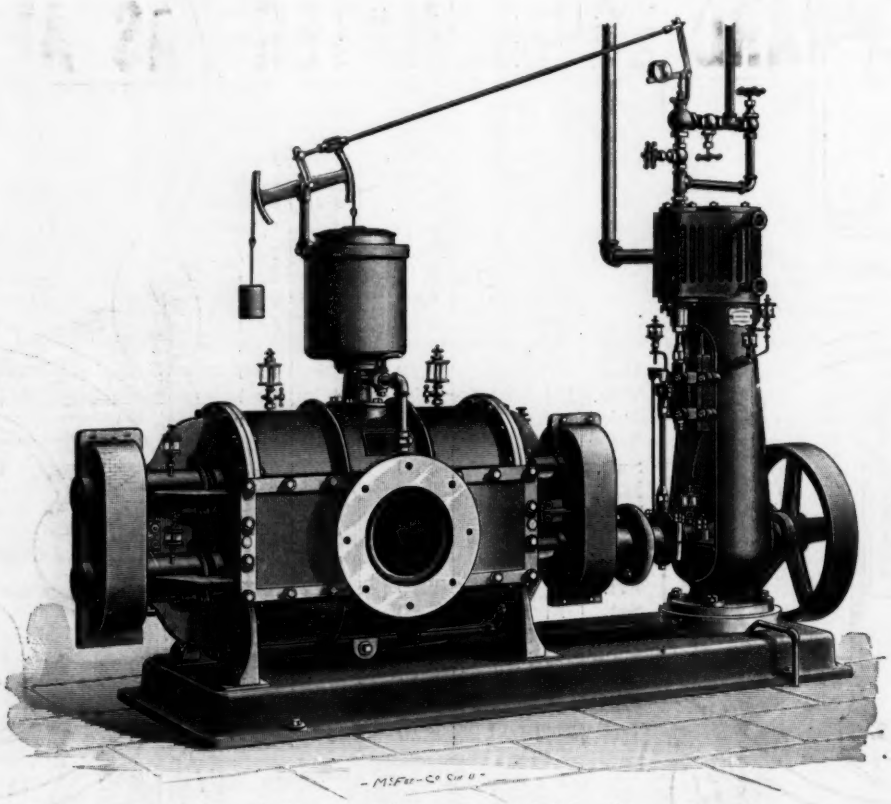
It is without question the most perfect Exhauster ever constructed.

Inquiries Cheerfully Answered.



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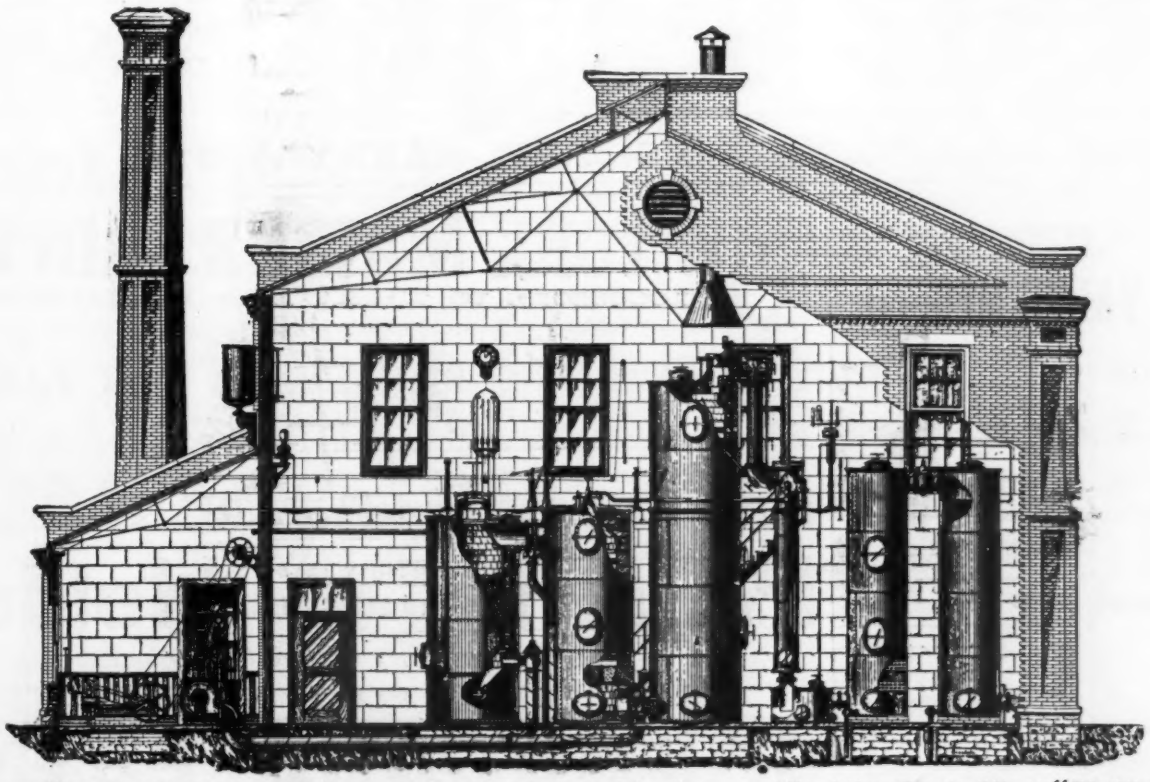

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Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

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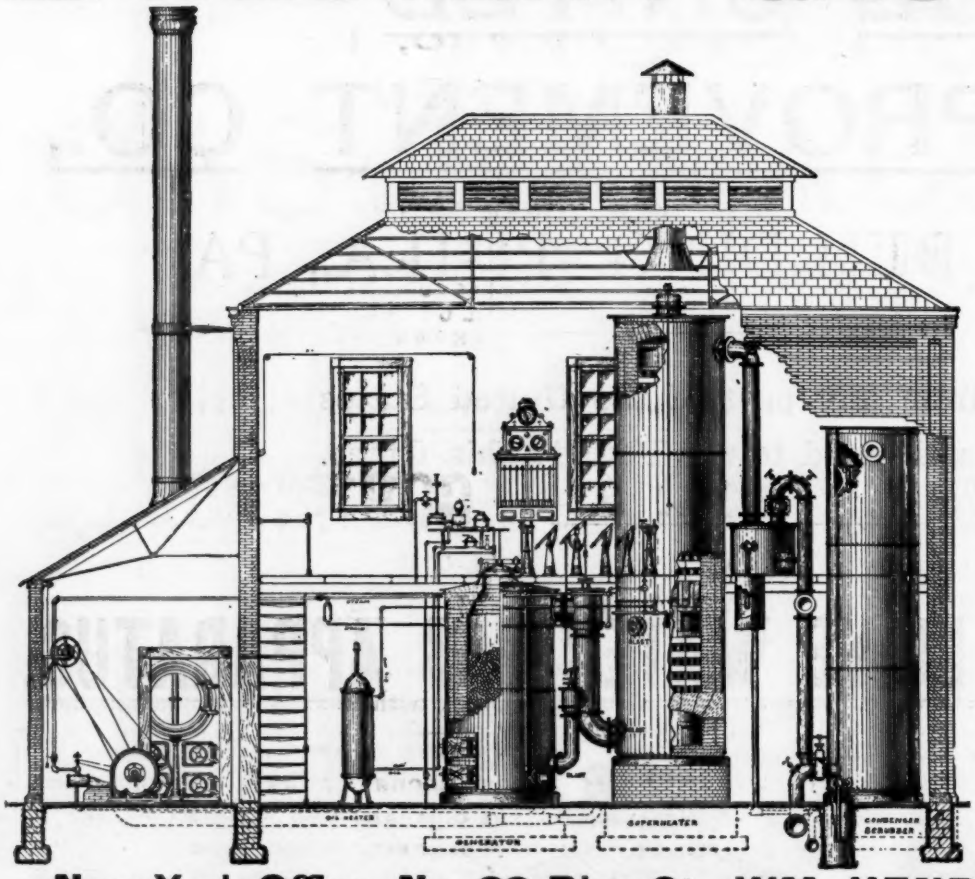

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Double and Single Gate, ½ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

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OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT!
WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION.
REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE!
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STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

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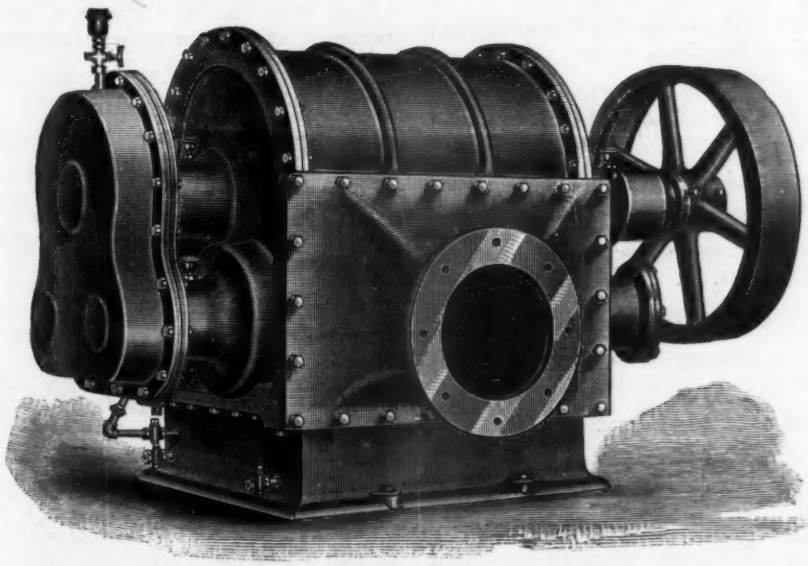

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Acts immediately, and more efficiently than any other purifying agent now in use.

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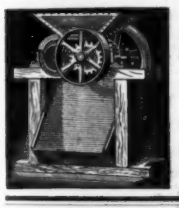

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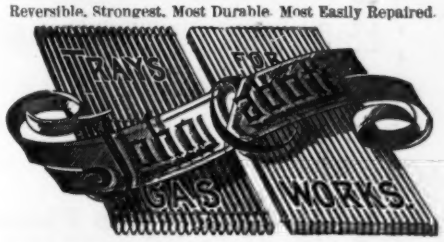

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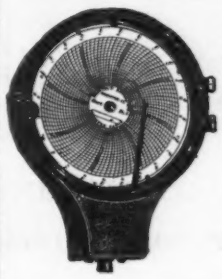

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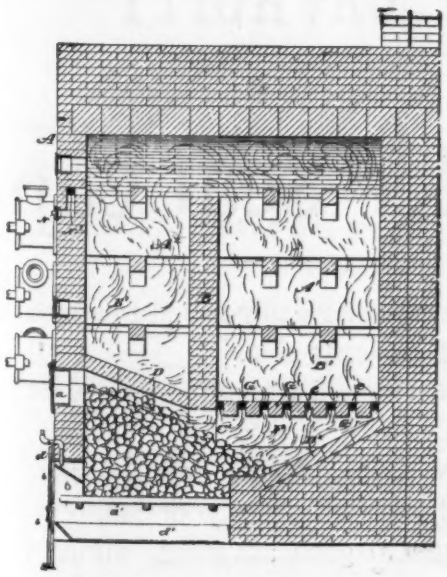

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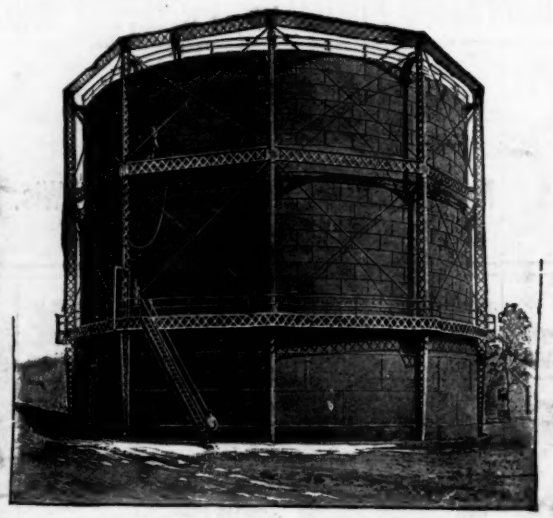

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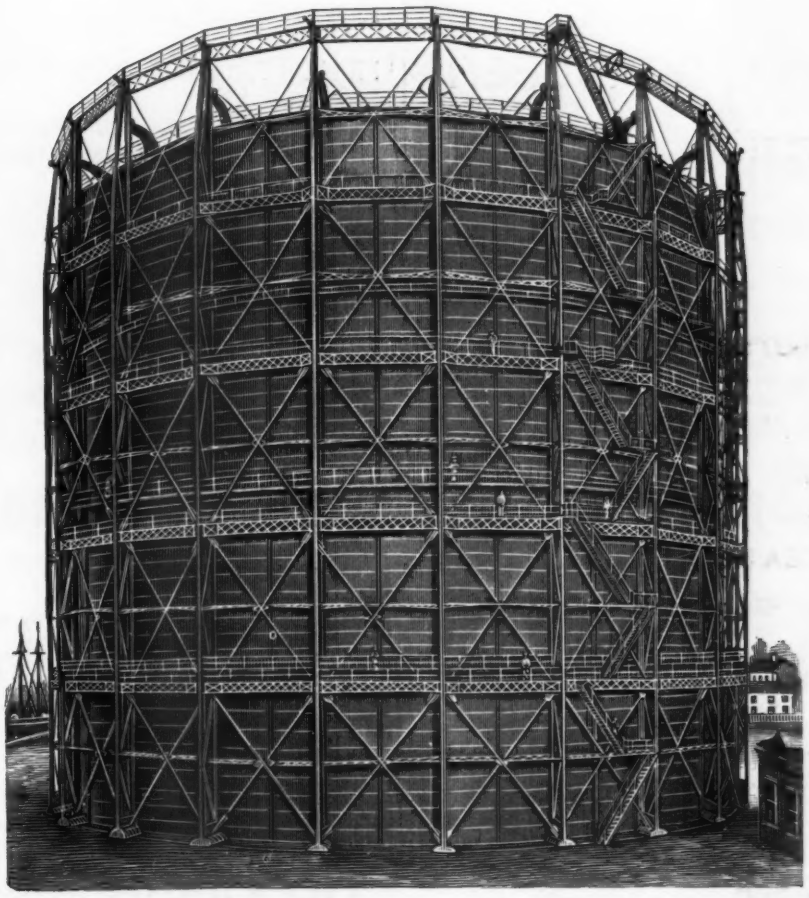

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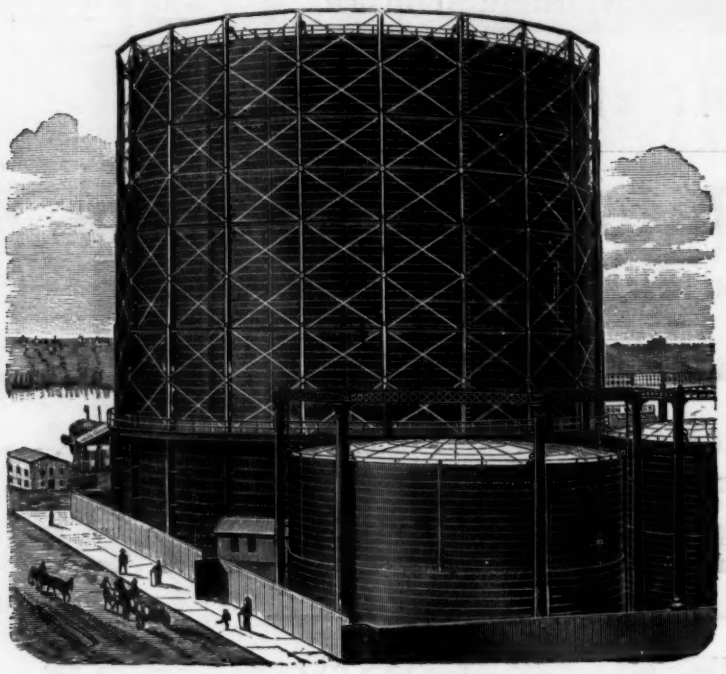

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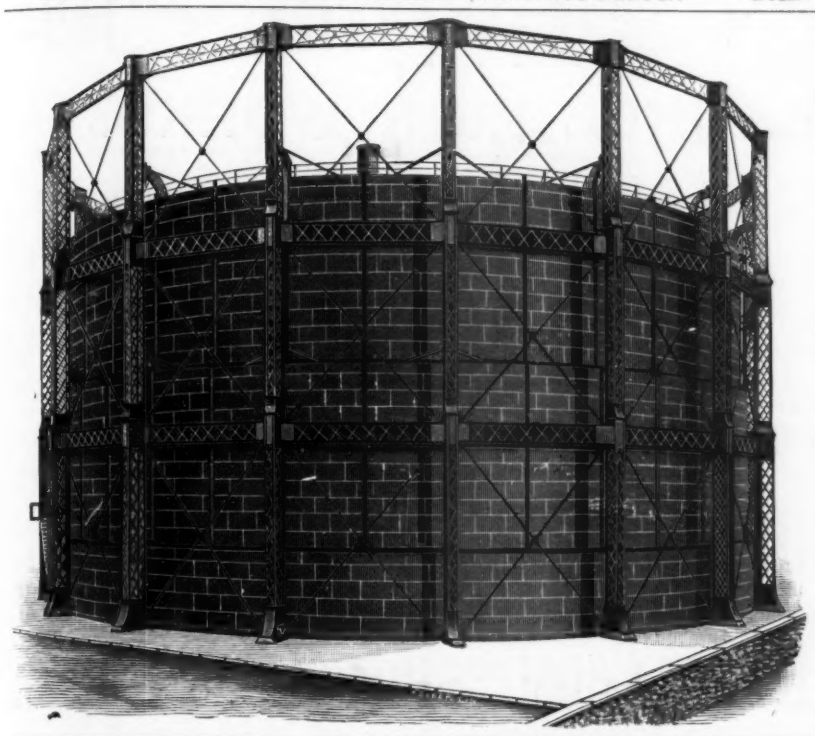

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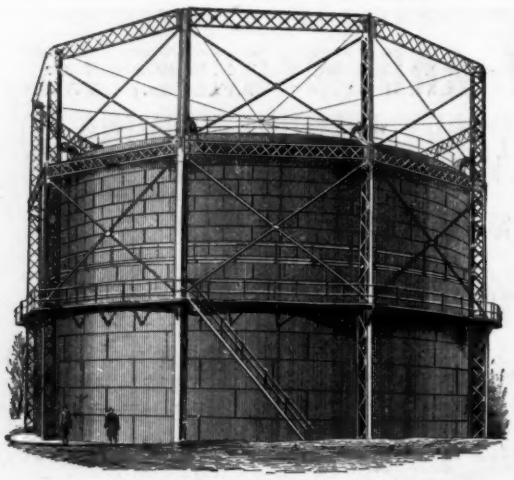

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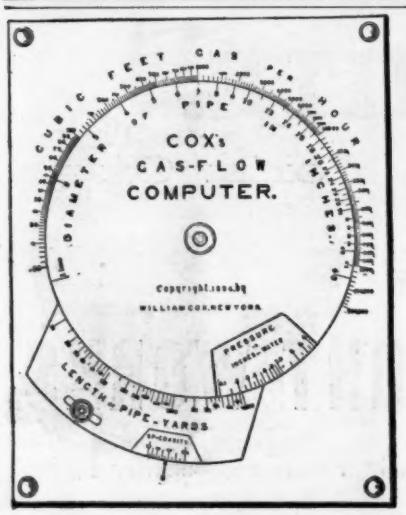

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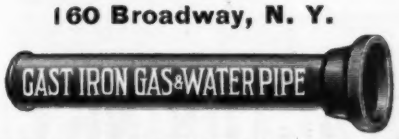

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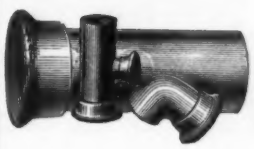

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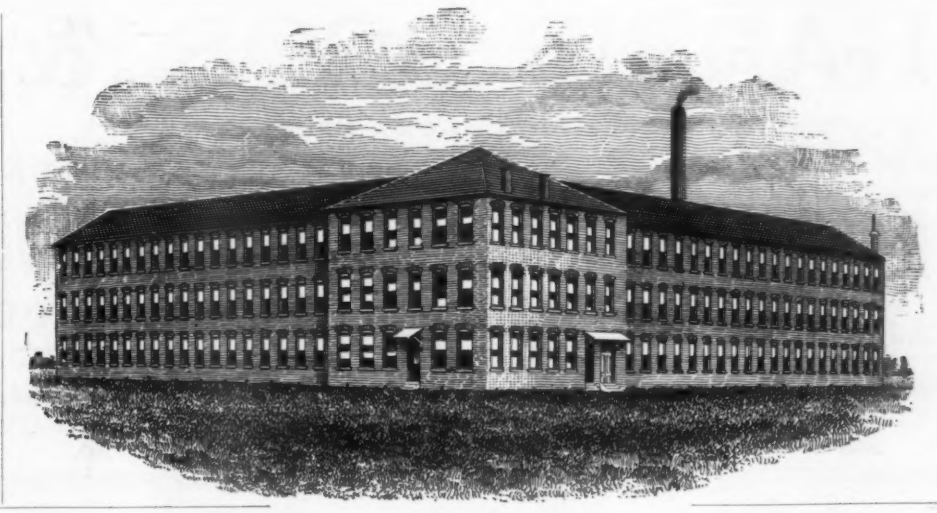

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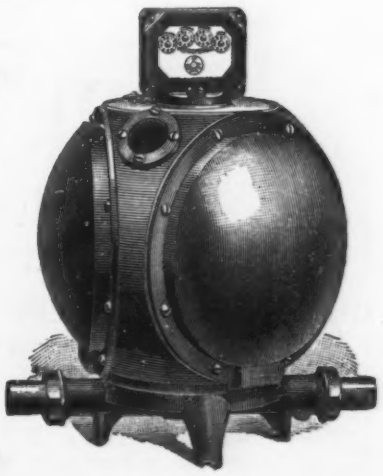

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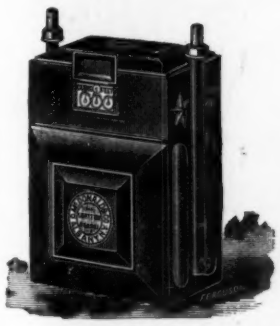

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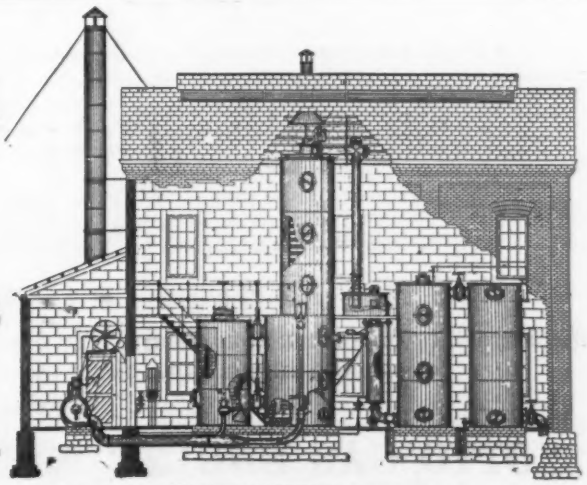

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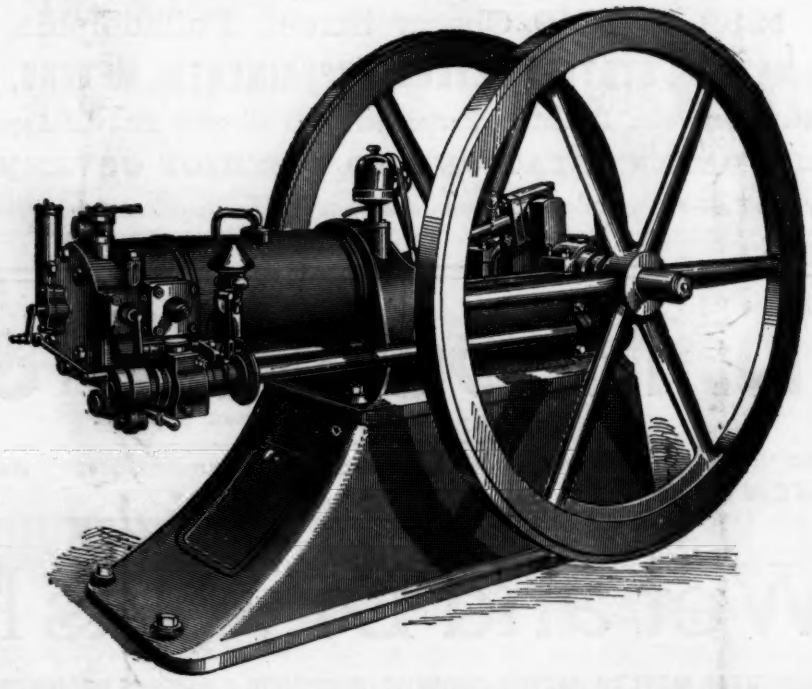

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